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The News Section

WITHIN the last two years the news section of this journal has been expanded so as to cover adequately the events of special interest to engineers and contractors. The news-gathering facilities have been increased and every effort made to report promptly all occurrences within the journal's scope. As a result much valuable data have been printed in its "Current News" section. Nevertheless, these pages have generally been thrown away and only the body of the paper bound. This was due to the ephemeral nature of much of the material, and to the fact that these pages were not indexed. With the betterment of this section of the journal has come the need for its preservation and, accordingly, beginning with this issue the news pages, excepting the "Contracting News," will be paged continuously with the body of the paper, and will be indexed as is the technical section. Readers who have heretofore thrown the news pages away will, therefore, need to take special note of this change.

The Romance of Engineering

TOO close attention to detail prevents full appreciation of a work as a whole. The draftsman who develops the design for the main pedestal of the Quebec Bridge is in grave danger of viewing the great structure from the prosaic angle of the loads it will carry, of the enormous total stresses to be cared for in the shoe, and is likely to lack appreciation of the sweeping lines of the structure and what as a whole it means in the history of bridge building. He is assisting in one of the modern labors of Hercules, but does not appreciate his task. Familiarity has destroyed his perspective. And he—this mythical engineer held up as a horrid example—is not an exception. Engineers generally are blind to the romance of their work, and see it only when it is brought out by a Kipling, a Hopkinson Smith, or a Richard Harding Davis. Pennell has immortalized the giant work at Panama, but no one has given adequate expression to the romance of bringing water 240 mi. across the desert to parching Los Angeles, of the cutting down of the hills which impeded Seattle's growth, or of burrowing beneath congested streets with no sign of activity above, to the end that New York City may the more easily carry back and forth its seething multitudes. It would be well for the engineer's estimate of his own place in human progress if he appreciated these broader aspects of his work. To those outside the profession, the character of his tasks make a strong appeal, and those with an artistic sense see in the equipment he uses opportunity for striking compositions. This is well shown by the cover of this issue of the Engineering Record. With masterly hand Louis Fancher had brought out the artistic possibilities of the mighty dredge which is digging the trench for the Narrows siphon. Prosaic, indeed is such an "outfit" to the engineer and to the contractor. Yet in its massive lines and giant strength Mr. Fancher sees the very embodiment of the fundamental principle of beauty—that a structure must be fitted for the work it is to do. Conceptions such as this and Pennell's Panama drawings give the engineer and contractor a new point of view, and should increase their appreciation of their tasks.

Hints for the Contractor

UNDER this head the Engineering Record will in future segregate short notes giving details which save time and labor on construction work. The average contractor is but little given to reading. He is too busy—or thinks he is—to do more than scan the "Contracting News," through which he keeps in touch with prospective work, judges of his fellow contractors through the prices they bid and senses the business condition of the country. The Engineering Record believes, however, that he can be induced to read more, provided the material is boiled down and presented where he can easily find it. It is in this belief that the short items will be segregated. It is hoped to make the section so valuable that no contractor, large or small, can afford to overlook it. Items of equal value have been printed weekly in the Engineering Record for many years. They have, however, been buried at the foot of a column or included in a paragraph in some longer article. By segregating them, it is hoped to bring them to the attention of a wider circle of readers. Engineers should appreciate that while aimed expressly at the contractor these notes should be of almost equal interest to them, for no one can intelligently design engineering works unless he knows something about the equipment needed for their construction and something also about its economy.

Permanent Boring Records

LOCAL engineering societies often make the mistake of believing that their only function is to hold meetings regularly once a month and listen to technical papers. While no one will deny that this is one of the important duties of such organizations there are other fields of usefulness beyond the four walls of the society's quarters which are rich in opportunity. An example of commendable outside activity on the part of an engineering organization is afforded by the Municipal Engineers of the City of New York in its efforts to collect and make available for future use samples of the countless borings which have been made in New York preparatory to the construction of tall buildings, subways, aqueducts, bridges and subaqueous tunnels. Those who have been following the work of the Municipal Engineers' committee for several years will be interested in learning of the appointment by the Board of Estimate last week of Dr. Charles P. Berkey, professor of geology at Columbia University, as custodian of the boring records. The plan is to place the samples of earth and rock in the American Museum of Natural History and Dr. Berkey will have charge of their selection, classification and preservation. With the data thus available both the city and the individual will be able in future to reduce the cost of preliminary investigation for engineering work. In fact, it is proposed to prepare a series of geological maps of New York and these will serve the same useful purpose, in subsurface investigations, as do the widely used topographic maps of the U. S. Geological Survey in work above ground. This kind of initiative makes the engineering society a factor in the community.

Indian Giving

"IT is expected that the constructive work suggested in the original report for the purpose of conserving and augmenting the net revenues of the carriers generally will be carried forward without interruption." Thus the Interstate Commerce Commission in its recent rate decision referred to the ten reforms proposed in the decision handed down last July. That the railroads are going to have difficulty in carrying out these suggestions is already evident. From Philadelphia come reports that the fight of the commuters against increased suburban rates is to be resumed with redoubled vigor, on the ground that the railroads, with their increased freight receipts, will not need increased passenger revenues. This attitude shows the readiness in many quarters to twist the argument both ways against the railroads. When the railroads were setting forth their crying need for more revenue their opponents, admitting the need, insisted that the railroads deserved no better so long as they allowed certain abuses and inconsistencies to continue. Yet each attempt to correct any of these evils is met with specious argument against this particular reform. Already State utility commissions have been shown that great as is the crime of free switching, to abolish it would be a greater one. And now comes the new argument from the Philadelphia commuters that the railroads no longer need the money they had been accused of donating to the said commuters in the shape of unreasonably low commutation rates, and should therefore be compelled to continue the donation. Evidently there is still much educational work to be done to prevent the public from taking back with the one hand what it bestows upon the railroads with the other. If the beneficiaries of each leak are allowed to prevent the stoppage of the leak, the railroads will have gained little or nothing.

Extension vs. Specialization

THE engineer who maintains a broad interest in the advance of science, in the progress of economic thought and in public affairs outside the range of his routine practice not only makes himself thereby a better citizen, but also tends to acquire points of view which yield a new insight into the bearing of his own specialty upon modern civilization. In a large sense, work of real professonal merit generally reaches out into fields a good deal removed from purely technical problems. It is not enough to-day to be a master of strain sheets in order to carry through the development of a bridge in a municipality where the ever mounting tax rate threatens betterment work at every stage, and the ability to meet men and a willingness to learn from others while pressing home one's own opinions are quite as important as competence in reading drawings or facility in writing specifications and reports.

Entire devotion of waking hours to problems of engineering would still leave the ambitious man far short of a detailed grasp of all its special lines of practice, and the question naturally arises as to how the expenditure of time upon affairs only distantly related can be justified. The answer is that the cultivation of a broad viewpoint is worth more as a supplement to expert knowledge and experience in a fairly limited field than the acquisition of similar detailed knowledge in another branch not intimately related to the first specialty. In the research laboratory and in the museum concentration upon closely limited fields of thought may be more safe than in engineering, which is ultimately a matter of commercial importance, but no better advice can be given to young and enthusiastic engineers than to cultivate wide interests along with intense specialization within the defined areas of their immediate employment. Successful relations with all sorts and conditions of men are next to impossible for an engineer whose mental horizon is bounded by the four walls of his office or by the range of his field equipment.

Electricity in Construction Work

WHEN the announcement is made that a contractor will finish an $8,000,000 job two years ahead of the estimated time of eight years it is natural to infer that his plant, layout and methods of construction are well worth studying. Several articles have appeared in the Engineering Record describing how record yardages of concrete masonry—65,290 yd. in a single month of twenty-four 8-hour working days—were placed in the Kensico dam of the Catskill aqueduct by means of derrick travelers mounted on concrete columns extending across the entire site. These articles, dealing principally with construction methods, are supplemented by another in this issue describing the contractor's plant.

The chief feature of the Kensico work is that practically all the plant is operated directly by alternating current, purchased at 1¾ cents per kilowatt-hour. That the installation is on a huge scale is apparent from Mr. Carroll's summary of equipment—60 rock drills, 16 locomotive cranes, 110 concrete buckets, two 2000-ft. cableways, 34 electric derricks, 25 air pumps and a rock-crushing plant with a capacity of 2400 tons in 8 hours. Obviously the choice between direct and alternating current was a vital consideration and experiences with derricks and drills in the marble quarries of Maine and Vermont led to the selection of the latter. Contractors will be particularly interested in Mr. Carroll's figures on load factor, power consumption and power distribution. The Kensico records have demonstrated that the remarkable simplicity and flexibility of an electric distribution system for contractor's work of this sort cannot be duplicated by cumbersome pipe lines for compressed air. With the electrically operated equipment there are no delays caused by freezing pipes, and plant can be shifted quickly from one position to another. Another advantage is the resale value of the electrical equipment; the copper can usually be sold for 90 per cent of its original cost, and the transformers always bring a high return. With the plant performance at the Kensico dam in mind one of Mr. Carroll's statements is particularly significant: "With the present development of electrical machinery there are only a few projects on which electricity could not be the sole source of power."

Should the Weight of a Sack of Cement Be Increased?

IT is human to favor what appears to be the more simple and the more logical of permissible alternatives. For that reason the proposal to change the weight of a sack of cement from 94 to 100 lb. generally meets with instant approval. Not only is 100 a good round figure, but 100 lb. of cement measures more nearly a cubic foot. Little wonder then that at first thought it seems desirable to change the weight to the higher figure. Little argument is needed—the round figures in both weight and in volume discourage careful analysis. As a result are we not expecting more than we are warranted from the prospective change—and it is prospective if rumors from the joint conference committee on cement specifications and tests are to be believed? Is there not, too, a broader aspect to be considered, to which this ready acquiescence to the increased proposal blinds us?

The chief argument in favor of the heavier package, aside from the evident fact that there is no good reason for retaining an odd weight like 94 lb., is that proportions are based on the sack, and that the sack is assumed to hold a cubic foot of cement. If then a package holding 6 lb. more is used, the result will be to insure a richer mix.

Two different aspects of the subject present themselves, depending upon who sets the proportions and determines the method of securing them in the field. If the proportioning is in the hands of a competent engineer and the structure is of sufficient importance, a stereotyped mixture, 1:2:4 or 1:3:6, will not be used, but the proportions for maximum density will be carefully found by experiment. Whether a sack of cement then contains 0.94 cu. ft. or 1 cu. ft. is a matter of indifference; the measuring boxes for sand and large aggregate will be built according to the sketches of the engineer, and the decimal does not worry him.

When, on the other hand, the stereotyped proportions are used, the expected advantages are based on the assumptions that boxes, wheelbarrows and hoppers are ready-built to even-cubic-feet capacity. This, of course, is not so, and where accurate proportioning is desired the boxes must be built for the particular job. On a great amount of work, however, measuring boxes are not used. A sack of cement is dumped into a wheelbarrow and its volume noted. Each batch then is to contain twice as much sand and four times as much stone, for a one-bag 1:2:4 mix. Or a sack full of sand is thrown into a wheelbarrow. Its displacement is then taken as a unit for the multiple quantities of fine and coarse aggregate. In both methods it is evident that it makes no difference whether the volume of the sack of cement is 0.94 cu. ft. or 1 cu. ft. It appears to this journal, therefore, that the advantages expected from the increase in weight have been overdrawn.

When all is said, however, it is not easy to escape the attractiveness of the 100-lb. sack, and sentiment, even if without good ground, is likely to grow in its favor unless some good reason against the change is adduced. Evidently the discussion above only fails to find any special advantage in the heavier package and does not produce any testimony against the proposed innovation. The objections to the change must come from the manufacturers, and they, so far as this journal knows, have not yet stated their side of the case. The direct money outlay in the transition to the larger sack (only 10 per cent of the present sacks will hold 100 lb. of cement if placed by present types of packing machinery) may be dismissed from consideration, for the change could be brought about only as present sacks wear out. A period of four years would probably see the retirement of all but a small percentage of the old containers. The cost to the manufacturer would lie in the extra handling on account of having two sizes of package, a matter that affects not a few plant operations, such as the receipt and storage of sacks and the arrangement of packing and shipping facilities. This extra expense would eventually have to be borne by the consumer. Whether it is justified by the results depends upon the estimate of the expense involved, and, as to this, the manufacturers must speak. As pointed out in this comment the gain to be expected is comparatively small.

One other phase of the subject is worth more than a passing thought. "The sack nuisance" is a common characterization by contractors of the return system necessary where 40 cents' worth of sack is necessary to ship a dollar's worth of cement. The handling of returns, their collection, inspection, bundling and shipment, together with the inevitable losses, are a constant annoyance to the contractor, while at the receiving end the returns are no less troublesome. It was to escape this nuisance that bulk shipments of cement were first suggested and have since been advocated. Before changing the package, therefore, it might be wise to consider carefully the possibility of eliminating the sack nuisance. This might be done by packing in paper. Fifty-pound paper bags are now feasible, and studies of the possibilities of an 80-lb. paper sack are under way. The higher breakage losses, and the cost of the unreturnable paper bags and of handling a greater number of packages for a shipment of given size, are offsetting disadvantages. Their magnitude can be determined only after detailed study.

Enough has been said to indicate that the question is not to be dismissed by a wave of the hand. Surely there should not be a change in weight of package without first considering the advantages as against the cost, and without studying the possibility of eliminating the present costly containers.

Some Thoughts on the Past Year's Activities

EXTENDED comment on the year's achievements is not called for in these columns, since the activities in each of the major branches of civil engineering are treated elsewhere in this issue by eminent specialists. Certain matters, however, because of their great importance or wide influence do warrant special mention, even though attention has been given them in the more extended reviews. The comments will necessarily concern subjects with little or no interconnection.

First place must be given to the practical completion and the opening of the Panama Canal—an achievement of the first magnitude in engineering, and a tribute to the technical and administrative ability of American engineers. While the original schedule called for the completion by the first of January, this year, the canal was ready and in service in August, certain auxiliary structures and the cleaning up being then the only remaining work. The engineer's chief interest in the canal is now past. There will be interesting operating data, but almost five months of continuous service indicate the suitability and reliability of the designs employed, so that many years will undoubtedly elapse before data of more than ordinary interest are to be expected in the service records of the equipment. It is worthy of note that there have been no serious breakdown or interruptions and no cases of disappointment in connection with important features of design.

Meriting second place is the continuance of the remarkable interest in highway improvement—an interest that has resulted in large appropriations and extensive construction. Activity is nation wide and all evidence points to an increase rather than a decrease in that activity in the near future. The demand for hard roads is at the forefront of the movement, and though some attention has been given to dirt roads, they have not received the consideration which their tremendous mileage warrants. In the hard-roads propaganda, the importance of continuous maintenance is becoming better and better appreciated. In types of surfaces, no material has in recent years made as great strides as concrete. Therein lies a danger. To the average contractor the concrete road seems easy to build. Although those with experience know that such is not the case. So keenly, in fact, do cement manufacturers appreciate the difficulties that they have placed inspectors throughout the country and have been able to make an inspection of practically every concrete road under construction in the United States. They have, in addition, endeavored to have specifications revised to conform with what is generally considered the best practice. Another great danger in connection with concrete roads is the common belief that they do not require any maintenance. While experience so far gathered indicates that their maintenance cost is low, the absence of any maintenance policy is sure to be followed by disaster. It is necessary to take care of cracks and pit holes as they become evident, and while such repair work seems almost trivial, each such opening is a point of weakness which grows and spreads with great rapidity. Undoubtedly the need for maintenance will be learned in time, but there are likely to be costly experiences if the present belief that concrete roads do not need regular attention goes unchecked.

Turning to the field of legislation, there are a number of movements affecting engineers or engineering works deserving of comment. The agitation for the licensing of engineers, so wide spread some years ago, has practically disappeared. The matter was up in Pennsylvania this year, and general and emphatic opposition was aroused. One new factor is entering the situation, however, which may result in changing materially the attitude of those, who, like this journal, are opposed to the general principle of licensing. The architects are pressing in many States for registration, and while the last convention of the American Institute of Architects refused to endorse licensing as a general policy, on the plea that this was a matter for local and not for National consideration, the sentiment at the convention leaned strongly in favor of the committee's report advocating the licensing policy. One of the salient features of architects' licensing laws is that buildings cannot be erected unless designed by or vouched for by licensed architects. In practice, this means that the engineer becomes subservient to the architect in building construction. Such is actually the case in Illinois and New Jersey. It may be contended that in some States where architects are licensed there is no difficulty in the engineer securing a certificate. While this is true, he secures the privilege of practising not as an engineer but as an architect and is thus obliged to sail under false colors. Certainly it is humiliating for a competent engineer to be prevented from practising his profession, so far as building design is concerned, unless he is willing to be styled an architect. Briefly put, where such conditions obtain the architect has a legal status, the engineer has none. While this does not change the argument that registration will not enable the State to bar incompetent engineers from practice, it certainly would seem to justify the registration of engineers if for no other purpose than to give them a legal status. Whether the annoyance caused is worth the gain is a debatable question.

In Federal matters the outstanding legislative incident of the year was the magnificent fight put up by Senator Burton against the river and harbor measure. That the Administration has been frightened by this exposure of the iniquity of pork-barrel legislation is indicated by the conference held at the White House last week at which the merits of the Newlands Bill were considered. While it is generally understood that the President and his cabinet advisers present did not reach any conclusion as to their stand on the measure, it is certain that sooner or later the essential principle of the Newlands Bill must be enacted into law. This principle is that all Government activities having to do with the use and conservation of water must be placed under the jurisdiction of one board. Such a body would have within its scope river and harbor improvements, irrigation, drainage, flood protection, hydroelectric development and, in fact, all Governmental activities concerned with water. As a result of Senator Burton's fight, both direct and through the arousing of public opinion, it is probable that the continuing form of contract will be revived and the distribution of river and harbor funds be placed on a saner basis.

Those interested in the Government's activities so far as engineering matters are concerned had hoped that the year 1914 would see the adoption of regulations governing the development of water power which, at the same time, would conserve the interests of the Government and would promote the development of powers now going to waste. Bills covering the subject have passed the House and are before Senate committees. In their present form, however, they are not likely to stimulate development, and it is sincerely hoped that while reserving for the people all of their present rights, the terms will be altered so that private capital will be warranted in making investments. It is sincerely hoped that legislation that will bring this about will be enacted early this year so that the waters now running to waste may be utilized.

REVIEW OF THE YEAR

Summary by Eminent Specialists of the Engineering Developments During 1914 with Forecasts of the Progress in the Immediate Future

Contributors

GEORGE W. FULLER
J. E. PENNYBACKER
EDGAR MARBURG
DANIEL W. MEAD
ALLEN HAZEN
C. F. LOWETH
F. H. NEWELL
W. A. ROGERS
SANFORD E. THOMPSON

THE RAILROADS FROM THE ENGINEERING POINT OF VIEW

By C. F. LOWETH
Chief Engineer, Chicago, Milwaukee & St. Paul Railway, Chicago

As the year 1913 was characterized by a dearth of railway engineering work, so was the year 1914, but to a greater degree. The fact is that constantly diminishing returns have forced most of the railroads to discontinue building into the future to anticipate the country's growth, and it may be safely predicted that when the projects to which the roads have already committed themselves are disposed of, they will be obliged to trim sail and confine themselves to the necessary maintenance of existing facilities until the numerous commissions and other similar bodies representing the people are willing to concede to railroad shareholders reasonable profits, consistent with the nature of the investments.

New Construction

New construction in the United States is practically at a standstill. Almost the only noteworthy piece of work of the year is the completion of the Northwestern Pacific in California. In Canada, where railroad development is still encouraged, and where credit was good until the outbreak of the European war, the Grand Trunk Pacific was pushed to completion, while the last gap in the Canadian Northern Pacific in British Columbia has been reduced to 48 miles.

Last month the Baltimore & Ohio Railway opened for traffic its $6,000,000 Magnolia cut-off, the last project in the $100,000,000 program of President Willard. About the same time the Louisville & Nashville Railroad put into service its new line in Tennessee and Alabama. The extensive grade reduction and second track work of the Chicago, Milwaukee & St. Paul Railway across the state of Iowa has been practically completed, and a considerable portion of similar work across the states of Minnesota and South Dakota has been put in service, although portions have been deferred. Rapid progress has been made on the Nicholson cut-off of the Delaware, Lackawanna & Western Railroad.

Terminals

Several large passenger terminals originally undertaken when the financial situation was more favorable were completed during 1914. The most notable of these is that of the Kansas City Union Terminal Railway, which has recently been placed in service, and is one of the finest passenger stations in the Country. Other large passenger terminals are those at Detroit, Spokane, Memphis and Vancouver, all opened during the last few months. The reconstructed station and ferry house of the Central Railroad of New Jersey at Jersey City was put in service, although certain track work is to be completed. A number of smaller stations have been completed: typical of the best of these is that of the New York Central Lines at Utica. New passenger station projects are the Union Station at Chicago, which will involve an expenditure of perhaps $60,000,000, and a new union station at St. Paul, involving over $12,000,000. The demands for new passenger stations have already become a very serious burden upon the revenues of the railroads, and the end is not in sight. They come from the towns as well as the cities.

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> —*C. F. Loweth.*

Of new freight yards the year presents few. The most important is the reconstructed Clearing Yard at Chicago, the operation of which will be watched with interest by railroad men. The Louisville & Nashville is building near Nashville one of the largest yards in the South.

The year's progress in notable railroad bridges is recounted elsewhere in this issue.

Tunnels and Subways

Work is progressing rapidly on the Rogers Pass tunnel of the Canadian Pacific, in the British Columbia Rocky Mountains. This tunnel will be five miles in length, double track, and its construction presents some novel features. The two and one-quarter mile Snoqualmie tunnel of the Chicago, Milwaukee & St. Paul Railway, through the Cascade Mountains in Washington, the headings of which met in August, is expected to be put into service, fully lined with concrete throughout, within a month from this writing. The five-mile tunnel project through the Rocky Mountains west of Denver for the joint use of that city and the Denver & Salt Lake Railroad, has been held up by a decision of the courts prohibiting the city from co-operating with the railroad. The Mount Royal tunnel at Montreal is making rapid progress. Several tunnel ventilation projects have been completed and others begun.

A large part of the extensive New York City subway program was put under contract during the year. In November a long delay was threatened by the action of a certain labor union in demanding strict enforcement of the law prohibiting the employment of aliens on public construction work. A test case is being prepared.

No decided advances have been made during the year in track or roadway design or maintenance. A number of roads are experimenting with very heavy rails of various composition, but none has reported important results.

Grade Crossing Elimination

There is an increasing demand for the elimination of grade crossings, and doubtless much of this work must proceed in spite of financial stringency. A considerable amount has been done in connection with the passenger terminals at Memphis, Kansas City and Spokane. The Northern Pacific Railway has begun an extensive piece of track elevation in Spokane, and similar work by the Pennsylvania Lines at Cleveland is nearing completion. In Chicago, as usual, a considerable amount of such work is under way, notably on the Chicago, Milwaukee & St. Paul and the Chicago, Rock Island & Pacific Railways; the Chicago, Milwaukee & St. Paul and Chicago & North Western Railways are elevating their adjoining tracks and yards for a considerable distance in Milwaukee. Some extensive track depression work is under way in Minneapolis, and much more is being demanded by the city.

Grade separation, either by elevation or depression, frequently involves extensive changes in industrial tracks and the industries served by such tracks. These readjustments in many cases involve very large sums, and have proven quite troublesome alike to the railroads and the industries. That the industries should bear these expenses seems quite proper, and has been agreed to in many cases. This is a feature of increasing importance in grade separation.

ELECTRIFICATION AND VALUATION

In railway electrification perhaps the most noteworthy event of the year is the project of the Chicago, Milwaukee & St. Paul Railway, which now has under way the electrification of two divisions, extending from Harlowton to Deerlodge, Montana, a distance of 230 miles. Eleven electric locomotives are already contracted for; it is expected that the work will be completed next summer. Overhead high-voltage direct-current will be used, the voltage having been increased from 2400 originally contemplated to 3000. A similar system is contemplated for the Mt. Royal tunnel at Montreal, and the Canadian Pacific is investigating electrification for its Rogers Pass tunnel, previously referred to. The electrified zone of the New York, New Haven & Hartford Railroad has been extended during the year from Stamford to New Haven. Several railroads are investigating the desirability and relative economy of electrification as against grade revision and double tracking, especially for mountain divisions.

The Federal valuation of railroads has been begun, and work has been started on some fifteen railroads scattered throughout the country, and is soon to start on a dozen others. Up to Sept. 1, about fifty parties had been put in the field, and about 5100 mi. of line had been covered by these parties. However, the work has as yet hardly started, there are numerous important details of procedure yet to be settled, and it is possible that the earlier orders giving the requirements for maps, profiles, inventories, etc., may be considerably modified. This work is of much greater magnitude than is generally imagined by those not acquainted with it.

THE FUTURE

The construction of 1000 mi. or so of new railroad in Alaska as a government project at a cost not to exceed $35,000,000 has been authorized by Congress. The construction will be in charge of a commission of three engineers. Thirteen parties were put in the field last summer and the report of the location and cost of the work may be expected soon and will be of much interest.

As to the future, much depends on important economic questions now before the numerous government and state commissions. The position of the railroads is anomalous in that to a large extent their managers cannot control either the income or the outgo. The lack of co-ordination in the numerous legislative and regulating functions very materially increases the tax on the revenues of the railroads and without any corresponding benefit to the public. As one instance of this may be cited the partial rate increase granted a few days since by the Interstate Commerce Commission to the railroads in Eastern territory, the benefit of which in some quarters was largely nullified by an adverse decision of the Pennsylvania Commission the following day. The Western railroads have a request pending for a small general advance in freight rates, and at the same time are in the throes of a demand from 55,000 enginemen and firemen for increased wages. Whether or not the railroads gain their rate request, it may be taken for granted they will lose in the wage contest. The recent recall of the full-crew law in Missouri is encouraging and at the same time shows the injustice of much of the anti-railroad legislation of the past few years.

PROGRESS IN WATER SUPPLY

By ALLEN HAZEN

Of Hazen, Whipple and Fuller, Consulting Engineers, New York City

THE year 1914 has seen the inauguration of few new water-supply enterprises of importance. The European war and the uncertainty as to financial matters were no doubt largely responsible. On the other hand, many works of importance have progressed toward completion.

NEW YORK CITY SUPPLIES

Among these the Catskill supply for the city of New York is the largest and most important. During the year the Ashokan reservoir, the main collecting basin of the new system, was filled for the first time to a considerable height and it is expected that it will be filled to the spillway early in 1915. The northern aqueduct from the Ashokan dam to the Kensico reservoir has been substantially completed during the year. Upon filling the pressure tunnel under the Hudson River and the adjoining Moodna siphon with water at full pressure for the first time, a leak developed owing to a crack or movement in the rock, on the west shore at the junction of the Moodna tunnel with the west shaft. This was what was apparently the best of sound ledge. To avoid weaknesses that might be left by repair, it has been determined to drive a new tunnel at a lower level under the defective rock and to block off and abandon the tunnel first driven. This work, now under way, will mean a year's delay in the time when water is first delivered to the city.

In the meantime the reduction in consumption in the city by finding and stopping waste has proceeded so far that the per capita use is less than for many years, and the reservoirs of the Croton system and of the other city supplies are sufficiently filled so that it is certain that no shortage of water will result.

Unequalled progress has been made in the construction of the Kensico dam, which is substantially as large as the Ashokan dam, although not holding back so much water. The great bulk of the masonry in this dam has been placed during the calendar year 1914. The main part of the dam has been carried to the flow line and while much work remains to be done the reservoir will be ready for filling as soon as the replaced section of the Moodna tunnel is ready.

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The city tunnels driven through solid rock at a great depth under the city to distribute the Catskill water at high pressure, and with but little friction loss, are approaching completion and will soon be ready for final test. Work on a cast-iron pipe line with flexible joints under the Narrows, from Brooklyn to Staten Island, to supply a rapidly growing and important part of New York City has been commenced. Novel and interesting methods of making the pipe joints tight under trying conditions are in use.

The work of filtering, treating and purifying city water supplies has gone forward during the year, progress on the construction of important plants at St. Louis, Cleveland, Baltimore, Montreal and Trenton being recorded.

NEW LAKE INTAKES

New intakes are being driven to furnish more lake water to Milwaukee and to Cleveland. The latter is being driven through the clay containing marsh gas that resulted in such frightful loss of life in the construction of a former intake. It remains to be seen if progess in the art of tunneling will permit the new intake to be driven through this dangerous material without a repetition of these accidents.

CANADA

The Canadian cities have been growing with great rapidity and a large proportion of them have new waterworks under way. Victoria and Winnipeg are constructing aqueducts to introduce new and larger sources of supply. The Victoria aqueduct is fed by a mountain reservoir 37 miles away, while at Winnipeg the soft water of Shoal Lake 95 miles to the east is to be secured. Montreal is proceeding with new works, and at Toronto a contract for the extension of the filter plant has been let, involving new principles that have not yet been tried out on a large scale.

At Ottawa a new or improved water supply has been the leading subject of popular discussion during 1914, as during several preceding years. Some progress has undoubtedly been made in crystallizing thought along more rational lines.

The extension of municipal ownership has not made great progress during the year. The unfortunate controversy at Denver still continues in the courts, the matter at direct issue now being the question of reduction of rates, which the city endeavored to force.

At Des Moines the city has twice voted not to provide the money for the purchase of the company's plant, which it had previously condemned, and on which a price had been fixed. The former proceeding has thus failed to take effect and the company still operates the plant.

At San Francisco a tentative agreement between the representatives of the Spring Valley Water Company and the city was reached as to the value of the works to be taken and as to the terms of purchase. It is understood that there will be a vote on the confirmation of this agreement by the city during the coming year.

It has been proposed that the state of New Jersey through the State Water Supply Commission, should take over the East Jersey Water Company and continue the wholesale business now done by it. The price of purchase has been fixed and further action is now pending.

Financial difficulties of the American Water Works & Guarantee Company, perhaps the largest single owner of water works properties in the United States, necessitated the reorganization of the company under a new management, and a new name. It is understood that the financial difficulties grew out of conditions not directly related to the waterworks properties and that these properties were on the whole prosperous and were paying their way.

The Peoples Water Company, supplying Oakland, Berkeley, Alameda and other California municipalities east of San Francisco Bay, became involved in financial difficulties early in the year and an effort is now under way to reorganize it upon sound financial lines. This company is one of the half-dozen largest remaining water companies in the United States, and it had been for years subject to close and perhaps excessive regulation by the municipalities served by it.

An amendment to the California Constitution was adopted at the November election which takes from municipalities the power to fix rates, and vests it in a State commission. This is believed to be a substantial step in advance.

The Salem fire and the behavior of the Salem waterworks is to be noted as one of the important happenings of the year. On June 25 a conflagration burned over 253 acres and destroyed property estimated to be worth $20,000,000, being more than a third of all that in the city. The waterworks furnished water as they were capable. Fortunately neighboring cities and towns with waterworks had pipe connections, and water was supplied from neighboring works until a rate of output was supported twice as great as that which would ordinarily be considered adequate for protection. It was afterwards ascertained that enormous quantities of water had been lost by broken pipes that had been laid to factories and other large buildings to feed automatic sprinklers, and for other fire protection purposes. The breakage of these pipes by falling buildings and the useless escape thereafter through them of great quantities of water was a dominating factor in the situation, and reminds one of the history of the San Francisco fire, where loss of water from service pipes broken by the earthquake and by falling buildings sapped the strength of the system and tended to prevent the check of the fire.

DEVELOPMENTS IN THE HYDROELECTRIC FIELD IN 1914

By DANIEL W. MEAD
Consulting Engineer, Madison, Wis.

SEVERAL reasons which have developed in the last few years have conspired, together with present conditions, to decrease the activities in hydroelectric development during 1914. In the first place, it has been emphasized that while undeveloped water power is energy going to waste, it frequently costs more to utilize such waste than can be realized by the saving so effected.

In the second place, the popular delusion as to the great potential value of undevoloped water power has made it possible to finance some projects on a basis that, while they may have proved advantageous to the promoters, have occasionally been disastrous to the investor.

In the third place, this same popular delusion has given rise to the theory that the States and the Nation are being robbed by a mythical water-power trust which has been seizing for its own profit valuable rights which belong to the people of the State and Nation. In consequence, much unfavorable legislation, both State and National, has so restricted opportunities that little development has been possible.

Investments are attractive when the returns are immediate and certain. It is only when the hope of reward is considerable that the investor will take part in enterprises that possess a degree of hazard.

Water powers do possess a serious hazard in both construction and maintenance, for they are necessarily built in the paths of flood and hence are subject, both during construction and operation, to casualties from such sources. Moreover, unless they are built for specific purposes, they must be near a good market and must be financed on a basis which will permit them to produce power at such a cost that it will both insure a profit and still be so low as to command the market. Occasionally there is a location where very favorable conditions prevail, but more often much time is needed before a satisfactory market can be developed.

WATCHFUL WAITING

As a rule, therefore, money invested in hydroelectric developments does not pay dividends as quickly as that invested in many other kinds of industrial undertakings. Usually interest must be provided from the capital account for a comparatively long construction period, as well as for a considerable time during which a market for the power is being developed. All of these factors affect the possibility of hydroelectric developments, and especially during financial depressions, such as that of 1914. The recent tariff changes have prevented cautious manufacturers from extending their plants and have not only prevented central stations from increasing their business, but have discouraged extensions and especially new installations. The pending water-power legislation has made investors adopt a policy of "watchful waiting," and, finally, the European war has opened channels for investment where quicker and larger returns can be expected than in the hydroelectric field.

The activities in this field have, therefore, consisted in the completion of a few developments, in most cases financed before the crisis. It has been impossible to find a market for large blocks of stocks or bonds of new undertakings, and the New York Stock Exchange and other exchanges were closed for four months or more during the year. The Senate is still holding hearings on the Adamson water power bill, which proposes regulations under which the government may lease power sites on navigable streams. The bill was passed by the House on Aug. 4. The Ferris bill, covering the use of water powers on the public domain, is also before a Senate committee, having passed the House on Aug. 24.

It has been proposed that the National Government control a new testing flume for water wheels in which better accommodations would be provided than are now afforded in the old flume at Holyoke, but no action has been taken, nor has the matter assumed definite form.

DESIGN

During the year, the maximum efficiency of high-speed, high-power turbine runners has advanced a few points. The Holyoke test report, dated April 1, of a Wellman-Seaver-Morgan model runner, giving 91.27 per cent efficiency, has been eclipsed by a more recent report on The James Leffel & Company's runnner 2359, which was reported to have developed an efficiency of 93 per cent. Such a wheel, built in large sizes and placed to operate under more favorable conditions and higher head than at Holyoke, will probably give between 95 and 96 per cent efficiency. This high efficiency, of course, is the efficiency of the turbine and not the hydraulic efficiency of the plant.

Material gain has also been made during the year in the increase of the power of turbines. Until recently the modern turbine has possessed a power coefficient of about 0.0024 at the speed for maximum efficiencies. This had already been increased, prior to 1913, to 0.00375 by one manufacturer, and in 1913 to 0.00423 by the S. Morgan Smith Company in Holyoke test 2208. In October, 1914, the maximum coefficient of 0.0047 was reached in Holyoke test 2363 by The James Leffel & Company.

For the first time automatically operating siphonic spillways have been used on a hydroelectric development in the United States. These siphons are located in the forebay of Development 2 of the Tennessee Power Company on the Ocoee River, and developed an efficiency of 65 per cent under test. The use of a rolling dam on a reclamation project in the United States extends back a number of years, but not until 1914 were such dams specified for hydroelectric developments in this country. Three rollers 65 ft. long and 19 ft. high are to be used at the Long Lake development of the Washington Water Power Company. As the stream has not been fully utilized as yet and a movable dam crest is not required at this time, only the fixed portion of the dam has been completed and the piers built so that when required the rollers can be erected.

CONSTRUCTION

Several big plants have been completed during the year, the most notable being the 160,000-hp development of the Cedar Rapids Manufacturing & Power Company, near Cedars, Quebec. The Big Creek station of the Pacific Light & Power Corporation, which was put in operation during the year, is notable because of its transmission line, which is 240 mi. long and operates under an initial pressure of 150,000 volts. The line is in complete duplicate, there being two lines of towers each carrying a single three-phase circuit.

Several large low-head plants have been put in operation, at Parr Shoals, Stevens Creek, Coon Rapids, Lock 12 in the Coosa River and at Prairie du Sac, Wisconsin. An interesting plant was completed in New York State during the summer, the 40,000-hp Salmon River development, which has a 2-mi. wooden pipe line of 12 and 11-ft. diameter, and a differential surge tank 205 ft. high. Experiments have shown that even under a load change of 75 per cent of the total capacity of the plant, the tank does not spill any water. On the distributor at the base of the tank the discharge in the penstocks is regulated by hydraulically operated needle valves of a type that only recently has been put on the market.

American engineers in Spain had completed two water power developments when the war broke out and work was stopped on the third, then about one-third completed. Because of the war, work has also ceased on a number of Canadian plants, that at Laurentide being the most notable. Even in the United States effects of the war have been felt, and work has been stopped on the Columbia Mills development at Minneto, N. Y. At Whitney, N. C., the Southern Aluminum Company, which operated on French capital and was building a large hydroelectric development, has been forced to suspend operations.

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>
> —*Daniel W. Mead.*

ACCIDENTS AND RECONSTRUCTION

Few accidents have happened, showing that more and more care is being exercised in design. At the Falls Village plant a penstock collapsed, and a concrete flume for the Naches power plant in Washington broke, causing an interruption in service for several days. The collapse of the Antelope siphon of the Los Angeles aqueduct showed forcibly the necessity of designing pipe lines so that negative pressures due to velocity changes can be resisted.

The Austin dam in Texas, across the Colorado River, which failed several years ago has been reconstructed. Parts of the old structure have been used and reinforced, while the new portion consists of a hollow reinforced concrete dam. Automatic flashboards 14 ft. high have been placed along the new crest, and 5-ft. automatic flashboards have been provided on top of the old portion.

In water-wheel testing the chemical method has for the first time been used in the United States. It was applied in two cases, the first for measuring the discharge through a 7200-hp horizontal eight-runner water turbine in the Croton development of the Grand Rapids-Muskegon Power Company, and the other in the station of the St. Lawrence Power Company, at Massena, N. Y. In the latter case it is stated that the accuracy was close to 0.1 of one per cent.

POSSIBLE MARKET

The success that has been obtained in the fixation of atmospheric nitrogen by means of electric power in Norway has led a number of American engineers to study this question. The idea has been to investigate whether the secondary power of large central stations could not be used in this manner, thus saving the cost of steam auxiliaries necessary to give such power market value. Water powers located in districts where no market is available and too far away from market possibilities, might then be given a commercial value; but all investigations have stranded on the impossibility of developing the power at a feasible cost. To use low-head developments is out of the question because of their comparatively high cost per horse power, and North America offers few high-head possibilities where power can be developed so cheaply that it can be sold at $5 or $6 per horse-power-year, as seems necessary for this purpose.

For the ensuing year the outlook is not bright, but it is to be expected that the lessons of the European war will encourage the American people to depend less upon imports and more upon domestic products. If this is coupled with a greater activity in the export trade, large industrial developments will be undertaken and the demand for water power may increase.

STEEL STRUCTURAL ENGINEERING

Some Phases of Its Past, Present and Future

By EDGAR MARBURG

Professor of Civil Engineering, University of Pennsylvania, Philadelphia

IN view of the brief space at his disposal and his distaste for purely statistical reviews, the writer will not attempt an extended compilation of data concerning recent accomplishments in the field assigned to him. He thinks it will prove more interesting and profitable to consider, first, some of the influences which have contributed notably to the advancement of steel structural engineering in America, to refer then to some conspicuous examples of present-day practice in its highest development, and to direct attention, finally, to a few of the many important problems of the future.

Following the introduction of the open-hearth steel process, wrought iron for structural purposes was superseded by steel about twenty years ago. The advancement since that time has probably exceeded the most farsighted anticipations.

PROGRESS IN DESIGN AND FABRICATION

The problems of design and fabrication are so closely interwoven that it seems best to treat them jointly in this brief review. Considering, first, the ordinary run of bridge work as distinguished from structures of exceptional magnitude, remarkable progress has been made within recent years, especially in connection with railroad bridges. The reason for this lies largely in the fact that the railroads have come to recognize the evils of that vicious system by which formerly tenders for bridges were solicited on the basis of little more than a profile of the site and general specifications, and contracts were closed at lump-sum figures on mere stress-sheet designs. Under that system, with its strenuous competitive features, the bridge companies found it difficult to secure work at a living profit, save by skimping details to the limit of conscience and ingenuity. The change to the pound-price plan, under increasingly competent supervision, has perhaps contributed more largely, though indirectly, towards the elevation of standards in American bridge practice than any other single influence. It is fortunate that this radical change of attitude between purchaser and manufacturer should have come about coincidently with the introduction of heavy engine and train loadings which are not likely to be much exceeded for many years, so that modern steel railroad bridges may at length be regarded as measurably permanent structures.

An important collateral factor towards the raising of standards in bridge work is to be found in the increasing use of the well-balanced specifications framed and maintained under the wise co-operative plan of the American Railway Engineering Association.

The realization that a bridge should be proportioned and braced to resist the action of the external forces as nearly as possible as an integral whole, has profoundly influenced American bridge practice within recent times. It has resulted in the increasing use of riveted trusses, riveted connections for members subject to stress reversal, stiff riveted bracing, riveted floorbeam connections, end floorbeams, solid ballasted floors, etc., and in the abandonment for railroad bridges of the rattletrap details in vogue twenty years ago. All-riveted trusses were used for the 408-ft. spans in the recent renewal of the Lachine Bridge; and have been adopted in the 581.5-ft. draw-span of the proposed Burrard Inlet Bridge, Vancouver, B. C., and in the design of the two 775-ft. channel spans of the Sciotoville Bridge across the Ohio, to which further reference will be made hereafter.

Remarkable progress has also been made within recent years in the fabrication of plates and rolled shapes in larger sizes, in drilling or reaming large joints or complete trusses after assembling at the shop, in the use of metal templates and in the tapering of long rivets. A few years ago the large riveted connections in view for the Sciotoville Bridge, involving gussets about 12 x 15 ft. and 1⅝ in. thick, exceeding those for the Quebec Bridge and the Hell Gate Arch, could not have been fabricated.

The development of the theory of secondary stresses has already had a wholesome effect upon the general and detailed design of trusses. Too much emphasis can hardly be laid on the importance of utilizing this added knowledge by avoiding conditions calculated to increase secondary stresses rather than by seeking to take them into quantitative account in justification of improper designs.

With respect to design in its bearing on the development of new types of structures, deserved prominence should be given to the rapid evolution of bascule and vertical lift bridges, and the more recent though no less radical changes in the design of train-sheds. The applicability of double-leaf bascule bridges has recently been much extended through the perfection of means of transmitting full direct stresses in addition to the shear across the central joint of the closed structure acting as a simple span.

Improvements in erection methods have kept well abreast of the advance of bridge construction in other directions. The evolution of the modern derrick car with a maximum boom-length of 110 ft.—capable of handling with a boom-length of 70 ft. a 115-ft. girder weighing 60 tons—and the development of locomotive crane, have within recent years completely revolutionized erection methods for the ordinary run of work. Their use has resulted in cheapening and accelerating erection.

The practice by which new bridges designed to replace existing ones are completely constructed to one side and then rolled into place is growing in favor and has led to some remarkable records. An especially sensational performance of this kind occurred recently on a Pennsylvania Railroad bridge over the Muskingum River when three 240-ft. double-track through bridges, weighing in the aggregate 3,500 tons, were moved laterally 45 ft. in 10 min. and 17 sec. between trains. The same method was recently applied, without interruption of traffic, to the installation of eleven new 175-ft. double-track deck spans weighing 600 tons each, in the reconstruction of the Ohio Connecting Bridge, below Pittsburgh.

The method by which bridges are constructed on barges and floated into place, and shifted or removed by that means, has found numerous recent applications with ingenious modifications to suit special needs. The most important and spectacular feat in that line will take place when the 640-ft. double-track suspended span of the Quebec Bridge, weighing 6,400 tons, will be floated into position and then lifted bodily to a height of 150 ft. above the water level to its final place in that structure. In its application to this bridge this method not only ensures a great reduction in the erection stresses by the pure cantilever method, but also obviates all hazard from sudden temperature changes in making the final central connection that would otherwise have had to be incurred.

There have also been many interesting recent performances in the adaptation of the cantilever method to the erection of simple spans and other structures to which space forbids more than bare reference. The approaching erection of the Hell Gate Arch will prove an especially noteworthy example of this kind.

Erection standards have been greatly raised through the previously mentioned improved shop processes, the use of electric power in the conduct and control of field operations, the development of modern tools, especially the pneumatic hammer, and the use of tapered rivets to ensure efficient upsetting. It has been demonstrated that 1¼-in. field rivets in the Hell Gate Arch, with a 9⅞-in. grip, and the 1⅛-in. rivets of nearly the same length in the Quebec Bridge, can thus be easily driven to fit for their entire length.

The scale which modern erection operations have attained may perhaps be set forth most impressively by the statement that the steel falseworks of the Quebec Bridge weigh 3,000 tons and that the two 225-ft.-high steel travelers weigh nearly 1,000 tons each, not to mention the material used in the 90-ton girder crane and the 495-ft. runways in the field storage yard.

Notable Bridges Under Construction and Projected

The fabrication of this bridge in the mammoth shop built primarily for that purpose is progressing rapidly. Of the total weight of steel—65,000 tons—about one-third has been fabricated and about 10,000 tons erected, one of the anchor arms being nearly completed. A world record was established about a month ago with the erection of 410 tons of steel in a single working day, including the driving of 16 large pins. No better evidence than this marvellous record could be adduced of the extreme care that had previously been bestowed upon every detail.

To engineers, the circumstance that the Quebec Bridge, with its channel span of 1,800 ft. between pier centers, will be the largest bridge in the world, is wholly secondary in interest to the many striking innovations in design, fabrication and erection to which it has given rise. Space precludes more than brief reference to a few of its principal features. First in importance is the straight-chord, K-truss design, involving a type of truss heretofore practically unknown in this country. Its advantages for long-span bridges have become so evident that their possible disregard by future designers under similar conditions will have to be professionally justified on more substantial ground than the mere striving for seeming originality. The K-truss is statically determinate, comparatively free from secondary stresses, admirably adapted to erection, and ensures the distribution of the shear in each panel between two principal web members, with obvious incidental advantages in other directions. To bridge engineers the conception of this truss should be as welcome as it was unexpected. Its striking originality is deserving of the most generous professional recognition.

NOTEWORTHY DETAILS

Among the details of this bridge perhaps the most noteworthy features are the admirable design of the truss members, the use of separate pins for individual members, the omission of the upper lateral system, the cradling, in lattice box-trusses, of the long top-chord eye-bars,—not only for their own support and for the lateral transmission of panel wind loading, but incidentally and in no unimportant degree for appearance,—the suspension of the transverse floorbeams in the central plane of the main trusses (which are in a certain sense double trusses), the use of pin bushings for greater flexibility at certain joints, the adoption of 100 per cent chord splices throughout, and of special trusses for the transmission of tractive forces.

In referring to so huge a structure, one readily yields to the temptation of citing especially significant figures. The main pedestals weigh 500 tons each; the 9 x 10-ft. main posts above the piers are 310 ft. long, have a cross-sectional area of 1903 sq. in. and weigh 1,500 tons each; the largest (7 ft. 2 in. x 10 ft. 4 in.) lower-chord member has a length of about 85 ft., a cross-sectional area of 1902 sq. in. and a weight of about 420 tons, though it will be erected and assembled in four parts; the largest pin is 30 in. in diameter, with 45-in. bushings, and weighs about 6 tons.

According to schedule the Quebec Bridge will be completed in 1917.

The erection of the Hell-Gate Arch, designed by Gustav Lindenthal, will be begun next April and finished in about four months. On the Long Island side the temporary anchors for erecting the arch cantilever-fashion are nearly completed and preparations for their installation on the Ward's Island side are in progress. With its span of 977.5 ft. between centers of end hinges this arch will be the largest structure of its type in the world. Apart from the extraordinary boldness and originality of the general design, this bridge contains many new features of unusual interest, notably the rocker joints at the chord splices designed to minimize eccentricity of chord stress, the cantilever arrangement of the lower laterals, and the braking girders for the transmission of tractive forces.

The total weight of steel in the arch proper is 20,000 tons, the heaviest bottom chord section having a shipping weight of 150 tons. The cross-sectional area of this member is 1385 sq. in., but it is necessary to ship it in longitudinal halves.

The entire completion of the bridge with its long approaches is expected by the end of 1916.

SCIOTOVILLE BRIDGE

This bridge, also designed by Gustav Lindenthal, to which reference in print is made here, by special permission, for the first time, will cross the Ohio River on the line of the Chesapeake & Ohio Northern Railway. It is a proposed double-track structure, about 3500 ft. long, with two 775-ft. channel spans.

The design marks a radical departure from current practice in that the main trusses will be constructed as all-riveted continuous girders over three supports. Taking advantage of the rock foundations at the site, the designer will thus effect an estimated saving of about four million pounds of steel, in comparison with an alternative plan involving the use of two independent spans. The contract for the masonry of this bridge has been let and work on the foundations is in progress. The detailed plans of the superstructure have been completed, but the award of the contract is in abeyance.

OTHER LARGE BRIDGES

Other large bridges for which the contracts for the steel superstructure have been let are the Memphis Cantilever Bridge across the Mississippi River, designed by Ralph Modjeski, which, with a maximum span of about 790 ft., will supplement the present structure in the immediate vicinity; and the Metropolis Bridge across the Ohio, designed by C. H. Cartlidge, in which the longest simple span has a length of about 723 ft. between pier centers.

IMPORTANT BRIDGE PROJECTS

The delay or indefinite postponement of large bridge projects will doubtless be among the many consequences of the European War. Under present conditions the consummation of such mammoth projects as the 2880-ft. North River Trussed-Cable Suspension Bridge, and the proposed San Francisco Bay Cantilever Bridge, with three 2000-ft. spans, seem sufficiently remote. Other long-discussed and recently revived projects are those for a 1071-ft. cantilever bridge across the Mississippi at New Orleans, and a 1600-ft. cantilever bridge across the mouth of Sydney Harbor, Australia. The live load for the latter is 15,000 lb. per foot of bridge, or nearly 50 per cent. higher than for the Quebec Bridge. The life of its steelwork is estimated at 100 years, or safely in excess of the prospective life of the estimator. Between two alternative designs, the one for a K-truss, the other for a sub-triangular truss, the Parliamentary Public Works Commission has recommended the latter.

RECONSTRUCTION AND REINFORCEMENT

Broadly speaking, every important bridge built 25 or more years ago has been either reinforced or displaced on account of increased loading. The plans for increasing the capacity of the Queensboro Bridge by rearranging the tracks will necessitate reinforcement and other changes in the floor-system, at an estimated cost of over three million dollars, although this bridge has been in service for scarcely more than a single decade. The plans for reconstructing the previously reinforced Brooklyn Bridge involve the entire replacement of the suspended structure.

> **"Considering, first, the ordinary run of bridge work as distinguished from structures of exceptional magnitude, remarkable progress has been made within recent years, especially in connection with railroad bridges.**
>
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>
> —*Edgar Marburg.*

The recently completed reinforcement of the Williamsburgh Bridge had as its crowning feature a cleverly contrived bit of bridge surgery in a midnight operation involving the replacement of four 10-in. carbon-steel pins by 13-in. pins of nickel steel.

STEEL BUILDING CONSTRUCTION

The completion of the Equitable Building, New York City, now in course of construction, will be a notable event in that it will usher into existence the largest office building in the world. With three stories below ground, 36 main stories and two intermediate stories, it occupies a ground space of a little more than an acre, so that it will afford a floor space of nearly 40 acres. The cross-sectional area of the largest column is 393 sq. in., as against a maximum column section of 700 sq. in. in the 57-story Woolworth Building.

Unfortunately, space does not permit reference to some of the many other notable building operations recently completed or now in progress.

Important Lines of Future Progress

ALLOY STEELS

With the materials now available for structural purposes, a span of about 2000 ft. may be regarded as the maximum practicable limit for cantilever bridges. For longer spans recourse must be had to some form of suspension bridge. Signs are not wanting, however, that we are on the eve of important developments in the field of alloy steels. With more exhaustive investigations of their possibilities, improved metallurgical and manufacturing processes, and substantial reductions of cost, alloy steels are destined to become factors of increasing importance in the design of long-span bridges; nor is it improbable that they will in time displace carbon steel entirely for structural and many other purposes.

In the meantime, it is interesting to note that the material problem has been variously met in the important bridges included in this review, although in part under radically different determining conditions, by the adoption, separately or in combination, of standard carbon steel, higher-carbon steel, high-silicon (and high-manganese) steel, nickel steel, and "Mayari" steel. The last, a natural alloy nickel-chromium steel, will be used extensively, and for the first time for structural purposes, in the Memphis Bridge and the high-silicon steel in the Metropolis Bridge, for compression members only.

Since the moduli of elasticity of alloy steels and carbon steels are practically equal, elastic deformations and, therefore, deflections and secondary stresses, will be emphasized with the increased unit stresses. This element will require careful attention both in design and erection, but is not likely to entail difficulties of governing weight.

FULL-SIZE TESTS

The need of extensive full-size tests on steel compression members remains almost as great as ever, although the tests on models of Quebec Bridge members have yielded some valuable data. The returns from the tests by the Bureau of Standards, now in progress under the joint auspices of committees of the American Society of Civil Engineers and the American Railway Engineering Association, are awaited with great interest. Much full-size experimental work, both in tension and compression, will be needed before the relative merits of the various alloy steels can be safely judged.

OBSERVATIONS ON THE ELASTIC BEHAVIOR OF STRUCTURES

It seems highly desirable to perfect means of ascertaining not only the dead and live-load stresses in important structures, but also the secondary stresses, within fair limits of accuracy through observations on their elastic movements. On the Beaver and Winner bridges permanent contact points for extensometer measurements were established before their erection some years ago, but the results from subsequent observations have not been publicly disclosed. It is to be hoped that the experience had with these tests will be fully reported with suggestions for overcoming any difficulties that may have been unexpectedly encountered. The fact that within the elastic limit of the material every member is practically a perfect spring under axial stress, should lead to valuable developments, especially under static loading, in this important though singularly neglected field.

It is also to be hoped that the important investigations, by committees of the American Railway Engineering Association, on secondary stresses and on the effect of "impact" on the stresses in railroad bridges will be actively continued.

LOAD ASSUMPTIONS

The opinion that, with present, clearance, Cooper's E-60 loading will be ample for future needs and that possible increased traction requirements will be met by engines of the Mallet articulated type, which assure a more favorable distribution of the loading on bridges and track, seems to be well-grounded. In some quarters provision for somewhat increased clearances for new bridges is advocated as precautionary measure against possible future needs.

The question of rational assumptions as to live loading for large multi-track bridges, in which the conditions may be further complicated by wide stretches for highway traffic, still presents, however, one of the most perplexing problems with which the structural engineer has to deal. This is especially true for types of structures, including cantilever bridges, in which the conditions for maximum stress in certain members require the concurrent full loading of two or more parts, with the intervening parts wholly free from load. It is hardly to be doubted that live-load assumptions have occasionally been made whose realization is scarcely more likely than an earthquake visitation. This question is of such fundamental importance that it is not only worthy of much greater study than it has heretofore received, preferably on the part of a well-chosen committee, but it also points to the desirability of systematic traffic studies on important existing bridges, for the gradual accumulation of authentic data as an important step towards gaging present and probable future needs.

The rapid corrosion of steel structures exposed to the gases and blast of locomotives is now prevented by incasing the exposed parts in concrete. But the great problem of steel protection in general, under ordinary conditions of exposure, remains unsolved. New discoveries as to properties of alloys, and recent radical improvements in the application of metallic coatings, may yet lead to a practical solution in that direction.

ADVANCES IN SEWAGE DISPOSAL

By GEORGE W. FULLER
Consulting Engineer, New York

PRACTICAL accomplishments in the field of sewage disposal advanced steadily during 1914 without any extraordinary events to record. The Federal Government and several cities have continued important investigations in their general field, and there have been a number of treatment plants out under contract. None of them has been of unusual size, and construction work on the whole has probably been rather active than in other recent years.

GENERAL STATUS

Two-story settling tanks and fine screens have established themselves more securely as suitable forms of preliminary treatment for certain conditions. Sprinkling filters likewise have a somewhat more definite standing than a year ago, although it is to be noted that one sizable plant with contact beds was put under contract at Canton, Ohio.

The second plant installed at Atlanta, for the Peachtree Creek district, has now been in service for about 15 months. It is worthy of notice as bearing upon the influence of sewage works on land values that acreage land adjoining this plant at the time of its construction has since been subdivided into lots some of which abut the sludge-drying bed. The increase in these land values since the plant was built and put into service has been from two to four-fold.

Trade wastes have come in for rather more than an ordinary amount of study, particularly as regards the industrial wastes from the stock yards district of Chicago and with respect to several types of trade wastes under study by the Public Health Service of the Federal Government.

Electrolytic methods, aeration, and utilization of sludge, in combination with yeast, phosphate and potash compounds, have received more or less attention. Their standing as to efficiency and cost has not yet been established in sufficiently definite terms to justify here a review of details.

The city of Baltimore has made some progress in studying the digestion of sludge in tanks separate from those used for sedimentation purposes.

INTERNATIONAL BOUNDARY WATERS

The Federal Government, in co-operation with the Canadian Government, has obtained and published valuable data bearing upon the pollution of the boundary waters between the United States and Canada. Steps have been taken to establish a suitable policy to adopt in restricting the pollution of several of these waters, particularly those of the St. Marys, Detroit, Niagara, and St. John Rivers.

Consideration has been given to the proposition of what restriction should be placed on the pollution of waters used as a source of water supply becoming so great as to overburden unreasonably the capacity of modern water-filtration plants. Consideration has also been given to restricting the pollution of international boundary waters by the sewage discharges of boats, with the object of preventing a recurrence of epidemics of typhoid fever owing to the use of a water supply secured at random from these water away from the ports.

INTERSTATE BOUNDARY WATERS

No data or conclusions have been published as yet as a result of the continued investigations by the Federal Government on the pollution of the Potomac and Ohio Rivers.

Little progress has been made in the matter of the litigation brought by the State of New York in the United States Supreme Court to restrain the State of New Jersey and the Passaic Valley Sewerage Commissioners from discharging sewage into New York Bay near Robbins Reef Light. The outfall tunnel and the system of multiple outlet pipes on the bottom of the harbor are now under construction. Delay arose in printing the voluminous record setting forth the testimony offered in this suit through the efforts of the office of the corporation counsel of New York Ciy. In consequence of this delay the New Jersey authorities made a motion to have this case dismissed, but such motion was recently denied by the United States Supreme Court.

Record is to be made of a step in advance in the efforts undertaken by the New Jersey States Board of Health to compel the town of Phillipsburg, N. J., to cease polluting the Delaware River. The Chancery Court has handed down a decision granting an injunction to compel the town of Phillipsburg to cease polluting the waters of the Delaware River by its sewage and to make such disposal thereof as shall be approved by the State Board of Health. This decision is of importance in establishing the authority of the State in dealing with sewage, particularly that discharged into interstate waters. The town of Phillipsburg appealed this decision to the Court of Errors and Appeals.

ACTIVITIES OF MUNICIPALITIES

The city of New York has published a comprehensive report upon the metropolitan sewerage problem that concluded the work of the Metropolitan Sewerage Commission, the successor of which was the New York Sewer Plan Commission. The latter has been succeeded by the Bureau of Sewer Plan of the Board of Estimate and Apportionment. This bureau, comprising the Mayor, president of the Board of Aldermen and president of the Borough of Brooklyn, gives administrative authority for the engineering work which is being continued under the direction of the consulting engineers to each of the borough presidents, and under the chairmanship of the chief engineer of the Board of Estimate and Apportionment. Important testing stations to show the efficiency of different sewage treatment devices have been conducted by the boroughs of Brooklyn and Richmond.

Philadelphia has apparently concluded its studies relative to the general arrangements for the collection and treatment of the city's sewage. It is stated that the general plans have gone to the State Department of Health for their consideration, but that the final report on the projects has not left the hands of the printer. It is announced that the sewage and first flush of rainfall from the present sewer system will be conveyed to three treatment works. At the two main plants the sewage will be clarified by two-story sedimentation tanks of the Imhoff type. The digested sludge will be dried and used for filling low land adjacent to the works. The third plant will deal with a comparatively small amount of sewage at present, and here fine screening will be adopted and the resulting sludge incinerated.

Milwaukee has recently put in service an elaborate testing station for securing results to aid in deciding upon the best type of treatment works to protect the watercourses within and adjacent to the city. Cincinnati has published a comprehensive report on improved sewerage which shows with much completeness the needs of that community.

Cleveland has continued its investigations, paying particular attention to the use of fine screens. Indianapolis has conducted a sewage testing station for the greater portion of the year with a view to deciding upon means of correcting the grossly polluted White River at and below that city.

CO-OPERATION BETWEEN MUNICIPALITIES

The past year saw sewage treatment works placed under contract for the joint use of Plainfield, N. J., and two neighboring boroughs. This work is undertaken in conformity with the Enabling Act set forth in Chapter 112 of the Laws of 1910, of New Jersey, and indicates the conclusion of a matter that has been under dispute for some six or seven years.

In Pennsylvania a number of co-operative plants have been projected for smaller municipalities. At Pasadena, Cal., a joint project has also been under consideration.

In Illinois a new sanitary district to the immediate north of the Chicago District has been formed and designated as the "North Shore Sanitary District." It comprises a narrow strip of land adjoining Lake Michigan and on which are located some seven cities and towns.

Preliminary steps have been taken towards the establishment of a similar sanitary district to the south of the Chicago Sanitary District, in the State of Indiana, in the vicinity of the Calumet River, through which most of the sewage of the proposed new district now flows across the area of the Chicago District and into Lake Michigan.

At Atlanta two large sedimentation plants of the two-story or Imhoff type have now been in use sufficiently long to demonstrate their suitability in effecting clarification without odor, even when the effluent is applied to sprinkling filters, and permitting the removal of inodorous sludge, which is easily dried.

At some of the smaller plants of the Imhoff type some difficulty has been experienced in keeping the sedimentation compartment free of scum. Frequent and thorough removal of such scum seems to be desirable. Care is needed to guard against excessive gasification in the digestion compartment, particularly when the tank is first started and following the removal of much sludge.

Septicization of sludge varies with the organic matter and the kinds of bacteria that become established in the digestion compartments, and it has been found at the Pennypack Creek plant at Philadelphia that the continuous application of lime reduces the acidity and promotes the procuring of sludge of a satisfactory quality.

> **"Two-story settling tanks and fine screens have established themselves more securely as suitable forms of preliminary treatment for certain conditions. Sprinkling filters likewise have a somewhat more definite standing than a year ago, although it is to be hoped that one sizable plant with contact beds was put under contract at Canton, Ohio."**
>
> *—George W. Fuller.*

STERILIZATION

Sterilization or disinfection has made steady advances during the past year. Liquid chlorine, particularly for small plants, seems to be coming into more and more favor, as viewed by some State authorities. The reason of this appears to be that it seems less likely, through inadequate attention, to cause complications, such as the clogging of orifices and pipe lines, and particularly to give erratic results on account of the insufficient stirring of hypochlorite of lime, with consequent failure to dissolve the available chlorine therefrom.

TIGHT SEWERS

More and more attention has been given to the prevention of the unsatisfactory and expensive consequences of having sewers with leaky joints. Several contracts for vitrified pipe sewers were made during 1914 where no mortar joints were used, but in place of them bituminous joints were employed, together with cast-iron pipe for very wet soil.

Several places have been found where tight street sewers do not alone prevent the difficulty, as serious leakage has developed in house connections which were laid without proper engineering supervision. This suggests the need of overhauling the plumbing codes in this respect, and of proper enforcement of such regulations. In fact, it is understood that the Iowa State Board of Health is taking steps to see that local authorities take proper precautions to guard against leakage on all new sewerage work.

OPERATION OF TREATMENT WORKS

American experience in the operation of treatment works of various types is now accumulating with considerable rapidity. It is gratifying to record that the larger plants are operated under technical supervision, including laboratory control. Unfortunately, the smaller plants are not in many cases operated as well as they should be.

Interest in efficient operation by those having charge of small plants ought to be and probably has been stimulated by the instructive set of articles recently published by F. E. Daniels, director of sewerage inspection, New Jersey State Boar dof Health. Fortunately these articles are soon to appear in book form.

In speaking of the literature of the year 1914, mention should be made of a notable addition through the appearance of the first volume of a series on "American Sewerage Practice" by Messrs. Leonard Metcalf and Harrison P. Eddy. This first volume deals thoroughly with the "Design of Sewers."

CONCRETE AND REINFORCED CONCRETE IN 1914

By SANFORD E. THOMPSON
Consulting Engineer, Boston

THE year 1914 has been remarkable for the small number of private enterprises undertaken, not only in concrete but in all lines of construction. On the other hand, a number of large and important pieces of work, many of them begun in previous years, have been carried on; in fact, the period is notable for the magnitude of many of the jobs. At the present time there is a prospect of a gradual improvement in conditions in structural lines during 1915.

As a structural material, concrete is at last taking a place where the matter of safety under load and durability under normal conditions is unquestioned, and the selection of reinforced concrete is dictated simply by comparative economy and adaptability to the given design.

The fireproofness of reinforced concrete has been put to a most severe test recently in the conflagration in the Edison factories at West Orange, N. J. The advance reports recently published in the Engineering Record indicate that while the effect of the terrible heat—a heat greater than any known structural material could resist—combined with the water has played havoc in certain parts even of the concrete buildings, the condition of these is remarkable in comparison with the tangled ruins of the adjacent brick and steel, and brick and wood structures. As a matter of fact repairs already are being made and it is proposed to remove only a small portion of two floors of one building. Several injured columns are being cut out and replaced, while others are being strengthened.

Important along investigational lines has been the search for more exact knowledge of the properties of the materials used in reinforced concrete and of the exact action of completed structures under load.

In the building end of the field we find the more up-to-date contractors introducing more systematic methods of management with a view to reducing costs and bettering workmanship. This has been along the lines of design of plant and also of more systematic planning of their work, standardizing methods and tools, and in certain cases paying the men an added wage for accomplishing their jobs in the time and by methods laid out in advance. In other words, the contractors are introducing methods of management that have already been applied so successfully in manufacturing plants.

Progress in these directions means better work at less cost with, as a consequence, an ever widening field for concrete.

TESTS

The most notable series of tests of reinforced concrete brought out during the past year is that on bond between concrete and steel conducted at the University of Illinois by Duff A. Abrams. The theoretical and structural considerations in the design of flat-slab floors are attracting much attention and several series of tests are now in progress which undoubtedly will throw further light on this problem. In plain concrete, the fundamental importance of which is frequently neglected because of the more interesting features of reinforced concrete, tests made by various universities under the direction of a committee of the American Concrete Institute have resulted in extremely valuable conclusions relating to the sizes of specimens to be employed in tests; the variation in crushing load due to the size and height of the specimen; and the effect of different ages, different percentages of water, and different methods of storage. A cylinder with a height double its diameter, preferably 6 in. in diameter by 12 in. long, or 8 in. in diameter by 16 in. long, is recommended. At the same time the comparative tests in compression of short cylinders and cubes at different ages give means for determining the approximate corrections for other sizes and ages which do not correspond exactly to the recommended dimensions.

In July last, at the convention of the American Society for Testing Materials, a new committee, Committee C-9, on Standard Tests of Concrete and Concrete Aggregates, was organized, and is co-operating with the American Concrete Institute committee to develop still further the standardization of tests and the studies of aggregates. This committee has been split up into sub-committees (each comprising three or four men experienced in special lines), the work of which includes standard methods of tests for concrete and laws of mechanical mixtures; methods of sampling and testing field concrete; relative values of various strength tests; investigation of impurities affecting fine aggregates; standard methods of testing for voids, weights, density, specific gravity and consistency; methods of tests for coarse aggregates; and the gathering of data relative to available aggregates for concrete.

CONCRETE ROADS

The difficulty in producing a satisfactory pavement to withstand both teaming and auto traffic has resulted, in many localities, in a resort to cement concrete. Some of this work has been experimental, while many sections of road of considerable length have been built. Engineers in charge of this class of work, as well as the contractors handling the jobs, are only just beginning to realize the absolute necessity of first-class materials as well as first-class workmanship. Many of the roads now under construction will ultimately fail and go to pieces under traffic, not because concrete as concrete is at fault, but because so many so-called practical constructors have not yet grown out of the belief, expressed to the writer several years ago by the chief engineer of a large railroad system, that "no cement is worth purchasing unless you can mix it up with mud dug out of the bed of a river and make good concrete."

The Conference on Concrete Road Building held in Chicago was a long step toward the standardization of methods and materials. The committee reports and rules for recommended practice have been issued in a 200-page volume, which is well worth the study of those interested in this branch of concrete work. The fundamental principles of practice recommended by the conference are: a clean and hard aggregate; coarse and well graded sand; rich mixture; careful proportioning; thorough mixture of materials; intelligent and thorough inspection; reinforcement in certain cases; special attention to sub-grade; a viscous plastic consistency of the concrete; and continuous protection from traffic for four weeks after laying, at the same time keeping the surface covered and moist.

> **"As a structural material, concrete is at last taking a place where the matter of safety under load and durability under normal conditions is unquestioned, and the selection of reinforced concrete is dictated simply by comparative economy and adaptability to the given design."**
>
> —*Sanford E. Thompson.*

IMPORTANT STRUCTURES

In spite of business depression, much private work has been carried to completion and the number of comprehensive schemes of public improvements in progress has been unusually large. The comparative cheapness of concrete as a structural material and its adaptability to a great variety of conditions, have played an important part in aiding the development of engineering construction.

The most prominent piece of work for which large quantities of concrete have been used is, of course, the Panama Canal, and as a direct result of its opening are the various jobs of local importance undertaken in many of the coast ports of the country.

NEW ENGLAND

In New England perhaps the most important job is the new plant of the Massachusetts Institute of Technology in Cambridge, where the buildings under construction would extend over 2500 lin. ft. if placed end to end. A number of industrial buildings of large size have been built, a few of them in the vicinity of Boston, others in central Massachusetts and central Connecticut. In Boston, an 8000-ft. subway was opened to traffic in October, and work is rapidly progressing on two more subways. Under the Directors of the Port of Boston considerable harbor work—a large dry dock, several large covered piers, and a bulkhead—is in hand. Elsewhere in New England, the new Grand Trunk extension has recently completed a number of small and medium-sized structures in connection with a great deal of bridge work. Providence has added a much needed subway to its transportation system. Fitchburg is using considerable concrete in its sewage disposal system, and on the Connecticut River important power development work is under way or recently completed.

MIDDLE ATLANTIC STATES

In the Middle Atlantic States, New York City, as usual, has done much harbor work and considerable is planned for the future. The new subway system, however, is easily the most conspicuous piece of work in the city. On the Catskill water supply system and on the State Barge Canal much progress has been made. On the Kensico dam, of the former project, 65,290 cu. yd. of concrete were placed during the month of May, a most remarkable record. This works out to 507 batches, two-yard batches per mixer per 8-hour day. Railroads usually attract less notice than public work, but the New York Connecting Railroad in the short distance of 3½ miles is using over half a million cubic yards of concrete. The Baltimore & Ohio has erected a large warehouse in New York, while the 12-story building of the Larkin Company in Philadelphia is notable for its size and the up-to-date methods of construction. The railroads of Pennsylvania have made many improvements, including, on Delaware, Lackawanna & Western, two viaducts, averaging 2000 ft. in length and a tunnel of over 3500 ft., the three projects involving close to 400,000 cu. yd. In a six-mile extension, the Lake Erie & Western Railroad used over 100,000 yd. in bridges and viaducts, and the Pennsylvania Railroad built two multiple-span concrete bridges of 2500 and 5000-ft. length. The Central Railroad of New Jersey selected reinforced concrete for an up-to-date locomotive terminal. In Philadelphia there has been put up the largest grain elevator in the world, and a new system of subways is being planned. Baltimore's work in concrete includes a comprehensive sewerage system and a water supply system with a large dam, a 2000-ft. tunnel, and a mechanical filtration plant. Considerable harbor work is also under way. A long viaduct has been built and progress has been made on the subways. Much of the work carried on has been unusually difficult, and at the same time on a large scale.

SOUTHERN STATES

Many of the coast harbors of the South are undergoing improvements and many concrete piers are being built. A large hydroelectric plant has recently been put into service on the Coosa River, which will mean much to the industrial development in this section of the New South. The building of cotton storage warehouses, inaugurated before the beginning of the war, is an interesting recognition of the saving in fire insurance premiums and the advantage of permanent structures. Several large bridges and viaducts have been put up during the year, together with a number of pieces of private work. One of the most important structures projected is the bridge over the Tennessee River at Chattanooga.

MIDDLE WESTERN STATES

Many cities in the Middle West are carrying out or planning large improvements, involving the use of concrete. Cincinnati, Milwaukee, Chicago and St. Louis are all at work on sewerage systems, Cleveland and St. Louis are building immense filtration plants, and Chicago a half-million-dollar tunnel. The new Soo Canal, with its locks, is one of the big jobs carried to completion during the year. Hydroelectric plants on the Mississippi and Ohio Rivers have been completed and a number of viaducts with an average length of 2000 ft. are under way or opened for traffic in Cincinnati, Pittsburgh and Columbus. A number of large privately owned buildings have gone up, the two Ford buildings in Detroit attracting most attention. The Chicago & Northwestern completed a 1300-ft. tunnel in Wisconsin, and the Union Station in Wichita, Kansas, has been opened to the public. Across the line in Canada, Winnipeg has awarded contracts for an 85-mile aqueduct to be built entirely of reinforced concrete.

PACIFIC STATES

The ports of the Pacific coast are building docks in preparation for the Canal trade. The Big Creek and Jordan River hydroelectric plants in California and Vancouver Island, respectively, are both large jobs, but the first is specially worthy of note, involving much difficult construction high up on the steep slope of the Sierra Nevada range. In San Francisco work is proceeding on the sewerage system, and two traffic tunnels, one 900 and the other 13,000 ft. long. The temporary purpose of the exposition buildings has in this instance relegated concrete to a secondary place.

The development in reinforced concrete stadiums for athletic contests has been interesting. Yale has her Bowl and Lehigh, Princeton, Michigan, and the College of the City of New York each a stadium, those of Lehigh and the New York college as yet unfinished.

THE FUTURE

Progress in reinforced concrete must continue along lines similar to those of the past few years. with more and more attention in practice to the theory of design; to the treatment of small details; to the design of joints in monolithic structures; to the selection of aggregates; to weathering qualities; and to economy in construction. On the artistic side there is coming an artificial stone of lasting quality produced under shop conditions and tool-dressed as is natural stone.

PROGRESS IN IRRIGATION, 1914

By F. H. NEWELL

Consulting Engineer, U. S. Reclamation Service

PROGRESS in irrigation development has been noteworthy, though confined largely to better use of the works already built. There has been steady advance by adding to the area of agricultural lands which has been brought under cultivation, with the result that the crop yields surpass in extent those of former years. The prices obtained by the farmers have been fair, and the irrigators have attained a greater degree of prosperity than ever before. This increase in crop production and values, however, has not been accompanied by a corresponding rate of progress in the building of new reservoirs and canals, nor by the initiation of new and more extensive projects. The real progress made in the matter has been not in visible works nor even in plans for such works, but in a better conception of the fundamentals which in due time will make further engineering works possible.

GENERAL CONDITIONS

In the past there has not been a proper appreciation of the underlying facts on which substantial progress in irrigation development could be made. It is only recently that, following many disappointments and losses, we have got down to the solid ground upon which may be executed future projects. The proof of this fact is found in the numberless wrecks of irrigation schemes which cumber a great part of the arid West. Various causes have been given for the more or less complete failure of these great projects, such as imperfect water supply, poor design or execution, unscrupulous financiering, and a hundred and one other reasons, each of which may apply to one or another particular case.

The real defect, however, is still further back and lies in the failure to appreciate thoroughly the deeper lying economic condition, namely, that the ultimate success of the investor and of the engineer and builder of irrigation works is dependent, not so much upon the mechanical perfection of the scheme as upon the way the irrigated lands are handled after the works are done. Too little thought has been given to the mental and physical make-up of the irrigator, whom now we recognize as the main support of the whole structure.

PROFITS IN IRRIGATED LAND

If an investor is considering a new manufacturing enterprise one of the first things upon which he obtains reliable information is as to the product and the market for it. It will not do to assume that because an article is a good thing, its production will be profitable and that a large investment is justified in building the factory. In the case of irrigation construction, the eyes of the investor have been dazzled by the assumed great profits in irrigating lands at a cost of say $50 an acre, which when irrigated have been placed on the market at from $100 to $150 per acre and upward. Apparently there is a great margin of profit. He has not looked deeply enough to find out whether this great increase in land prices is real or fictitious. It has been assumed as a matter of course that the farmer could and would make large payments for irrigated land. The reverse is the case, the average pioneer irrigator has not been able to make large payments, and while he may have agreed in good faith to buy land on deferred payments at high prices, yet as a rule he has not been able to carry out his agreements so optimistically entered into. The owner or investor has been compelled to grant more easy terms, and to make more and more concessions until the amount which he actually receives is less than his original investment, due allowance being made for loss of interest and decrease in value from depreciation.

In short, during 1914, the public has come to the appreciation of the fact that, for success in irrigation investments which lead to construction of large works, it is not enough to be sure of ample water supply and of economical construction. Beyond these, and far more difficult, are the human and agricultural conditions leading to the securing of competent farmers, men who have the skill and ability not only to raise good crops but to market these successfully.

ENGINEERING PROGRESS

In works built by private or corporate capital there has been little progress worthy of note. In the operations of the Government in the use of the Reclamation Fund there have been a number of large structures advanced towards completion and hundreds of smaller items completed. The Lahontan Dam on the Carson River in Nevada has been finished, this being a structure containing 770,000 cu. yd. of earth, with a maximum height of 124 ft., a length of 1600 ft. and with concrete spillways on each side converging to a concrete lined pool at the lower toe. The reservoir will hold 290,000 acre-feet and the water stored from the floods of Carson River and by diversion from Truckee River will be used to increase the supply for 200,000 acres in the Truckee-Carson project.

The Elephant Butte Dam on the Rio Grande in New Mexico, about 120 miles above El Paso, Texas, has been brought to a stage of completion where water can be stored in 1915. The work is notable from the rapid progress made in laying concrete, an aggregate of 306,000 yd. having been deposited during the year. This dam will contain about 500,000 cu. yd. with a maximum height of 290 ft. and a length of 1200 ft., and will provide storage for 2,627,700 acre-feet, holding all but the largest floods of the Rio Grande and having a capacity for 2-years' flow during drier years.

Rapid progress has also been made on the Arrowrock Dam, about 30 miles above Boise, Idaho, on the Boise River. This will be 1075 ft. long and 350 ft. in height, and is now within about 50 ft. of the top, so that water storage can be safely undertaken. The dam will contain about 530,000 cu. yd. of concrete, of which 444,000 was laid during the past year. It will furnish 230,000 acre-feet of storage. In this and in the Elephant Butte Dam sand-cement is being used, the commercial cement, together with an equal amount of fine sand or silica, obtained by crushing the adjacent granite and sandstone, being reground to pass a 200-mesh sieve.

In western Colorado, above the city of Grand Junction, the three main tunnels for the Grand Valley project, with an aggregate length of 12,670 ft. and a maximum capacity of 1425 acre-feet, have been nearly completed. These are lined with concrete and are intended primarily for the diversion of water for irrigation, but will serve also in part in connection with power development to be used for pumping water for irrigation.

IMPROVEMENTS IN METHODS

In engineering construction there has been a steady advance in methods of organization of the work and in economy in design and execution, as larger experience has been gained under the pioneer conditions which prevail in the West. The greatest advance, however, has been on the operating side, where, with additional data on the possibilities of water economy, it has been possible to devise regulations and carry out better methods of distribution of water.

One of the most notable steps is the requirement of the act of Aug. 13, 1914, providing for the payment of the operation and maintenance charges on the basis of the amount of water measured to each farm. The resulting conditions are analogous to those which have taken place when the water supply of a city is put upon a measuring basis. While there may be complaint and hardship in some cases, there is great gain to the whole community. The object of this provision of law is to bring about the result, which must necessarily follow, of greater economy in the use of water and in prevention of needless waste. Experience has shown that no amount of instruction or supervision can compare with the appeal to the pocketbook through charges based upon the quantity delivered.

Because of the impossibility in the past of enforcing economy, there has been a deplorable waste of water. The storage reservoirs provided to guard against scarcity have enabled an ample supply to be furnished to the farmers. They in turn, having paid for a water right and believing that if a little water is a good thing a lot is better, have lavishly used the ample supply. The result has been seepage and swamping of some of the best lower-lying lands until upwards of 20 per cent of the irrigated lands under public as well as private projects have been injured. Then comes the demand for drains; with adequate drains provided the irrigator feels that he is again relieved of the necessity of carefully handling his water, the drains quickly become overloaded, and more drains are called for. Meantime, the soil fertility is being washed away, and unless checked, the productive capacity rapidly deteriorates.

PROBABLE DEVELOPMENTS

The outlook for immediate construction of any large works is not particularly promising, but will unquestionably improve as the financial conditions become better. In the work of the Government the expenditures of the Reclamation Fund have been transferred from the discretion of the Secretary of the Interior to that of Congress, and many of the western citizens are hopeful that the Congress can be induced to add to the Reclamation Fund and push forward many large works which cannot be taken up immediately if expenditures are restricted to the fund as now established. On the Government projects the immediate need is for gradual increase of the distribution system and perfection of the drainage to keep pace with the changes in soil waters which take place, many of which cannot be safely predicted.

In the case of private projects, irrigation districts, etc., further construction is immediately dependent upon the ability to dispose of bonds many of which have been issued but not sold. Some of these bonds will undoubtedly be taken by contractors who will build the works at prices adjusted to the supposed value of the bonds and take their chances on disposing of them.

> **"The real defect lies in the failure to appreciate thoroughly the deeper lying economic condition, namely, that the ultimate success of the investor and of the engineer and builder of irrigation works is dependent, not so much upon the mechanical perfection of the scheme as upon the way the irrigated lands are handled after the works are done."**—*F. H. Newell.*

FINANCING PRIVATE PROJECTS

These and other irrigation securities placed on the market during 1914 may be considered under two headings:

First, those which are based on developed properties where the pioneer stage has been passed and real values have been created, but where money is needed to improve or enlarge the productive works, and

Second, those which are for the promotion of new enterprises where little or nothing has been accomplished and where even the question of water supply may be a matter of doubt, and where in effect the investors practically supply their own security.

The first class, with ample security on producing property, are worthy of public confidence, but unfortunately so many millions of dollars in face value of stock and bonds of dubious antecedents have been placed upon the market that the public, not knowing nor discriminating between the two classes, distrusts all alike. The good suffer with the bad.

From a physical standpoint there are almost endless opportunities for further development. Millions of acre-feet of flood waters are going to waste and hundreds of localities offer tempting opportunities for the construction of storage works. There are possibly 30,000,000 acres of good land which might be irrigated with the waters which may be had by storage or pumping.

FEDERAL AND STATE FINANCING

In recognition of this condition it has been urged that the Federal and State governments, either acting alone or in co-operation and without thought of interest on investment, must build future works. The National Government has already invested upwards of $100,000,000, sacrificing any possible interest earning, because of the belief that the benefit to the country as a whole is far more important than the earning of interest on the investment. Another way out of the present stagnation has been suggested. This is through the development of the irrigation district idea, by which the lands and properties benefited become subject to taxation for the building of the works. This course of action is possible only when there is enough real value existing in the lands, at the time the works are proposed, to serve as security for the investment. To be safe the money raised on this security must be so wisely invested that the works when built are not only worth what they cost, but enable the land owners to produce crops to a degree such that the farmers can keep up the heavy district taxes.

Most of the irrigation projects so far undertaken have been upon the somewhat fallacious basis of using the undeveloped property as security for a loan which in turn was to be used in creating larger values. It has been as difficult to accomplish this as in the traditional case of the man "lifting himself by his boot straps." Investors are no longer in the mood to advance the money to some other person to be invested.

The chief obstacle to advance, as just stated, is the financial one. As leading to the solution of this puzzling question of how to make progress, a conference was called in Denver in April, 1914, followed by the organization of an Interstate Irrigation Commission which held a preliminary meeting in Helena, Mont., on Oct. 1. At these conferences the financial problems were considered in part, and various ways and means discussed, but without conclusion.

REAL VALUE OF IRRIGATED LAND

The data recently collected regarding each farm on the Government projects have shown for the first time the real conditions, namely, that the average farmer under irrigation obtains a gross earning of about $25 per acre. When we allow say 5 per cent on the investment made, his net earnings are not much more than those of a day laborer. Out of these he must support his family and gradually build up his farm and equipment. This means that there is no such rapid increase in real value of irrigated land as has been assumed. On the contrary, it is safe to say that the irrigated land is worth the cost of the water, the value of labor intelligently put upon it, and very little more. The attempt of the promoter to realize upon an unearned increase in value results in most cases in simply robbing the irrigator of the proper fruits of his labor. In short, in financing irrigation projects, in future, there must be a true conception of the fact that there is no immediate profit to be legitimately obtained, but rather that the investment is one where, for the first few years, no interest nor dividends should be expected. Ultimately, however, the gradual increase in value will enable the payment of a low rate of interest on the investment, one which will justify such investment if carefully made on a sound engineering and economic basis. The indirect benefits to the community and to the State are, however, such as to render proper and desirable the use of public funds in many cases where the returns to the private investor may not be attractive.

FROM THE CONTRACTORS' POINT OF VIEW

By W. A. ROGERS

President, Bates & Rogers Construction Company, Chicago

IN general the year 1914 may be characterized as a quiet one in contract work. Little new work was undertaken in the latter half of 1913 and the conditions changed but little throughout 1914. In the beginning of the year it was felt that if the Interstate Commerce Commission would make a speedy, favorable decision on the railroad rate case, it would have a marked effect in restoring confidence. This decision was delayed until after its psychological effect on business was lost, and when made the increase was only a small part of that which the eastern railroads had asked for, and was restricted to one part of the territory. In addition to the general business conditions, which were very quiet during the early part of the year, business was further depressed in August by the European war. As an offset to the serious effects of the war, the country, especially the western part, has been blessed by bountiful crops.

Inasmuch as the contractor's business is, to a great extent, connected with improvements and extensions, it is one of the first lines to be affected adversely by a depressed business condition, and as a result the general contract business has been of less volume in 1914 than for a number of years past.

In this country very little new railroad work has been contracted for; that which has been advertised has been let at very close figures. In fact, prices have been lower in all lines than for a long time. This has been offset to some extent by the lower prices at which the contractor could buy his materials, and by a plentiful supply of labor, which could be secured at lower prices than have prevailed in past years. This applies especially to common labor. In addition, the efficiency of labor is always greater when a plentiful supply is obtainable than when there is scarcity, because it gives the contractor a chance for selection and the men are anxious to hold their jobs.

CONTRACTS MORE PLENTIFUL IN THE EAST

Contract work has been more plentiful east of the Mississippi River than west of it. Prices have been equalized to a considerable extent throughout the country. In fact, competition seems to be as keen on the Pacific as on the Atlantic Coast, and prices just as low.

> **"I believe that there should be a marked increase in the amount of work undertaken by the railroads in this country during 1915, starting gradually shortly after the first of the year. With a better business feeling there should also be more public work undertaken, and a goodly number of extensions of industrial plants."**—*W. A. Rogers.*

In the United States it is doubtful if there has been as much municipal and industrial contract work as in previous years. In Canada there has been practically no new railroad work and very little new municipal work. This has been brought about by several reasons; the extensive railroad development, consisting of the two transcontinental lines, has been practically completed during 1914, and great difficulty has been encountered in financing new projects on account of the European war.

ENCOURAGING SIGNS

It is difficult to prophesy as to what 1915 will bring forth. There are many encouraging signs. We are finding that the European war is bringing opportunities to this country which had not been expected. Foreign nations are buying largely from us in certain lines, which means that these industries are doing well, and this reacts on general business. One of the most important factors is the favorable decision of the Interstate Commerce Commission on the last increased rate request of the eastern railroads. This cannot fail to have a marked influence. It indicates a changed attitude on the part of the public, being reflected through the commission, toward the railroads. Irrespective of the actual money which the increased rates will bring, the decision should have a considerable influence on the ability of the railroads to finance new projects, improvements and extensions. With this in view I believe that there should be a marked increase in the amount of work undertaken by the railroads in this country during 1915, starting gradually shortly after the first of the year. With a better business feeling there should also be more public work undertaken, and a goodly number of extensions of industrial plants.

Some question exists as to the amount of future Government work, on account of the recent attitude toward so-called "pork barrel" legislation. There is grave danger that in attempting to cut off the expenditure of money for projects which are without value, those projects which are of great merit may suffer. If this happens, there will undoubtedly be a slowing down of Government contract work.

On the whole I feel that the outlook for 1915 is much brighter than it was for the preceding year, and I cannot but believe that we are starting on a new era of prosperity.

RECENT PROGRESS IN HIGHWAY ADMINISTRATION

By J. E. PENNYBACKER

Chief of Road Economics, U. S. Office of Public Roads

THE bare statement that 16,000 mi. of surfaced roads were constructed in the United States during 1913 and 18,000 mi. during 1914, or a total of 34,000 mi. in the brief period of two years, is impressive enough of itself, but it fails to convey an adequate conception of the really wonderful progress which America is making in the building and management of good roads. To properly grasp the significance of this great movement, it should be borne in mind that in 1904 there were in the United States only 153,500 mi. of surfaced roads of all types, and this included many thousand miles of road which, in the year 1914, would not be regarded as improved. In the brief period of ten years 96,000 mi. of surfaced road have been completed, which would mean an average yearly increase of 9600 mi. The year 1914, however, with its 18,000 mi., shows a rate of progress nearly double the average for the ten-year period, and is proof conclusive that, from a constructive standpoint, the movement is gathering momentum as it goes.

APPROPRIATIONS

That money is not being withheld, but is provided in lavish amount for the undertaking, may be gathered from the fact that the total outlay for 1914 will exceed $225,000,000. Again it is only by comparison with the outlay for earlier years that we can understand the great momentum which the good roads movement in America has attained. Back in 1904 the total expended for road purposes in all the states slightly exceeded $79,000,000. Thus, after a ten-year interval, we find our annual outlay has grown in magnitude 280 per cent.

Many recognized authorities have pointed out that a large percentage of this huge sum is wasted because it is expended under local control. Unquestionably this is true in very large measure, but we have every reason to feel gratified and amazed at the remarkable progress made during the past twenty years in the matter of road management. It must be remembered that in not a single state in the Union prior to 1891 was there a state highway department, and not a single dollar of state funds was appropriated in aid of road improvement. The New Jersey law of 1891 became effective in 1892, but it was not until 1894 that the position of state commissioner of public roads was created. During the past twenty years all of the states except Florida, Georgia, South Carolina, Indiana, Tennessee and Texas have established some form of highway department, and thirty of these forty-two states have granted direct aid to the improvement of the public roads. If state supervision and state aid mean efficiency in road work, we can take considerable comfort from the fact that to the close of 1914 something like $204,000,000 of state funds have been expended for road purposes and a total of something like 30,000 mi. of state-aided roads have been completed. The state outlay for 1914 exceeded the outlay for 1913 by $5,000,000, the totals being respectively $37,500,000 for 1913 and $42,500,000 for 1914. That the results under state aid are becoming evident at a rapidly increasing rate is proven by the fact that during 1913 and 1914 nearly 10,000 mi. of state-aided roads were completed, as compared with about 20,000 mi. for all the previous years.

Scope of State Control

It must be admitted that the efficiency of state highway departments is greatly hampered because their supervision extends to only a limited portion of the great system of 2,230,000 mi. of public highway in the United States. Most of this mileage is still under local control, but gradually state control is reaching out into the local field. Already the State of New York, by its elaborate system of aid to the various classes of highways, practically centralizes supervision in the state highway department. The same holds true of Pennsylvania. Last year the Iowa law placed all road work in the state under the direction of the state highway department. The trend is inevitably toward the centralizing of supervision in a state highway department so that the work throughout the state may be correlated and standardized and so that the efficiency of the highway department may replace the inefficiency which marks local control in many hundreds of counties.

Admittedly the weakness of state highway work in its earlier stages was the failure to provide efficient control and adequate funds for road maintenance. The result was that many thousand miles of well constructed highway were in serious danger of utter disintegration. This condition is rapidly being met by remedial legislation and large appropriations, and the much abused automobile is proving a saving factor in this crisis. During the first ten months of the year 1914, 1,750,000 automobiles have been registered, and it is estimated that the annual revenue from this registration will exceed $11,500,000. Most of this sum goes to the maintenance of state highways.

Progress in Individual States

The year 1914 was marked in the field of legislative enactment by the action of Kentucky in joining the ranks of state-aid states and providing a system of state roads. A levy of one-half mill tax has been authorized, which will provide about $600,000 annually, and this fund will be available for 1915. Colorado has also taken steps to provide adequate state road funds by authorizing, at the last election, a measure for a one-half mill state tax, which will provide about $500,000 per annum. Illinois, which enacted legislation in 1913 for state aid, actually got under way in 1914, and this year has awarded contracts for 100 mi. of improved roads. The appropriation for 1914 was $400,000, and for 1915, $700,000. An equal amount must be raised by the counties to make these appropriations available, and in addition an appropriation of $100,000 per annum was made for engineering and administrative work.

Mississippi took an important step looking to adequate supervision by providing that all roads built from county bond issues should be supervised by skilled highway engineers. California and Maryland have gone steadily ahead with the building of their state systems of highways by means of bond issues, California spending about $5,000,000 and Maryland authorizing an additional bond issue of $6,000,000 to carry on the work. In the states which have not taken favorable action for state supervision strong efforts are being made by good roads advocates. In Georgia a bill providing for a state highway commission passed the senate in 1914 but failed of final enactment. Indiana has taken up the subject in all seriousness and a commission appointed by the governor will make its report for consideration by the legislature this winter.

> **"The bare statement that 16,000 mi. of surfaced roads were constructed in the United States during 1913 and 18,000 mi. during 1914, or a total of 34,000 mi. in the brief period of two years, is impressive enough of itself, but it fails to convey an adequate conception of the really wonderful progress which America is making in the building and management of good roads."**
>
> —*J. E. Pennybacker.*

Activities of Federal Government

The Federal Government, during the year 1914, was more active in good roads work from a constructive standpoint than it has been since Congress discontinued appropriations for the Old National Highway prior to the Civil War. Under an appropriation of $500,000 made in August, 1912, work was begun late in 1913 and continued throughout 1914 in the construction of seventeen post roads having an aggregate length of 464 mi. The Federal appropriation was made available for these roads on condition that double the amount should be provided by the states or counties receiving the Federal aid, so that these projects represented an aggregate outlay under Government direction of at least $1,500,000. The roads are improved for the purpose of ascertaining the effect upon the operation of rural delivery and parcel post service through the possible increase in length of routes, the decrease in number of carriers, the decrease in number of days lost on account of bad road conditions, the saving to the community in increased traffic facilities, and the net cost of proper maintenance for these typical roads over and above the average local outlay. The most striking single project in the undertaking is the construction of a concrete road from Zanesville west over the old National Road, a distance of about 24 mi., for which the Government appropriated $120,000. To meet this appropriation there has been made available from counties and state about $320,000, making the total outlay approximately $440,000. The contractor is utilizing in the work labor-saving equipment, including an industrial railway and steam shovels.

In addition to the construction of post roads the Federal Government has continued its educational work on a large scale through supervising the construction of object lesson roads, testing road materials in its laboratories, building experimental roads to test new methods and materials, and conducting educational propaganda through the giving of lectures and the exhibition of road models in all parts of the country.

Highway Associations

In the field of voluntary organization the year 1914 is conspicuous for the formation of an official association of state highway commissioners and engineers. The preliminary organization meeting was held at Atlanta, Georgia, on Nov. 12, during the holding of the Fourth American Road Congress, and the formal organization was perfected in Washington on December 12 by the adoption of a constitution and by-laws and the election of officers. This new organization should find a useful field for its efforts in connection with Federal aid legislation; the standardization of the various details connected with the operation of state highway departments, and in the mutual exchange of information and advice.

That the organized road movement in America will be harmonized and co-ordinated through a co-operative arrangement between the American Highway Association and the American Road Builders' Association for the holding of joint congresses seems now reasonably well assured, as a joint committee of the two associations has already been appointed to work out ways and means for a great road meeting at San Francisco in 1915.

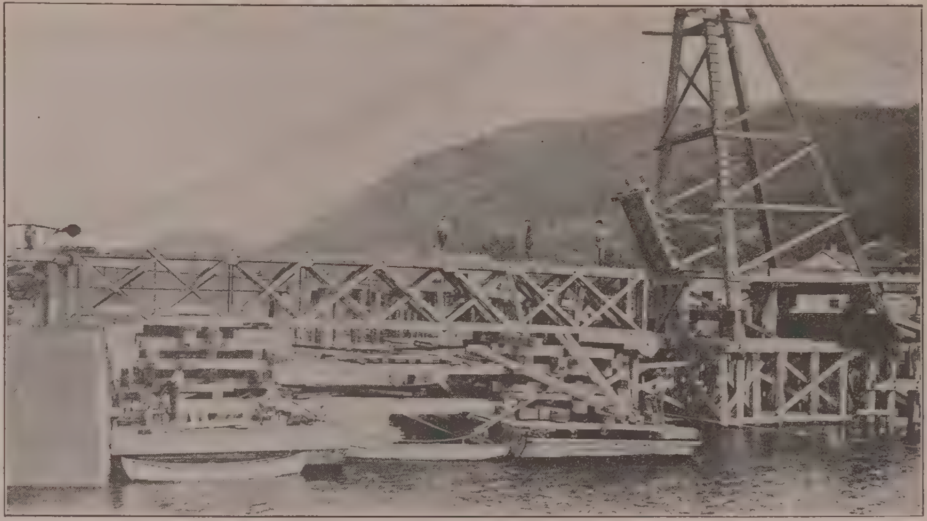
Federal Aid

That Federal aid to road improvement will be an actuality before a great while seems now to be generally regarded as a certainty. Hundreds of bills have been introduced in Congress within the past few years, and one bill, providing for a $25,000,000 appropriation, passed the House of Representatives by an overwhelming majority last winter. The difficulty in the enactment of Federal-aid legislation seems to lie in the inability of the advocates of the several plans now pending to reach an agreement. Certain fundamental bases of legislation are gradually becoming recognized, however, and will, in all probability, be embodied in the legislation which will ultimately become effective. Of these bases one is that the Federal Government should deal only with the states through their highway departments. Another basic condition should be that while initiative and actual supervision should rest with the states, the Federal appropriations should be safeguarded by retaining on behalf of the Federal Government sufficient powers of inspection and approval.

From the standpoint of financial outlay, effective legislation, development of methods, actual construction of improved highways, and provision for their maintenance, the progress in the United States during the past decade has been truly remarkable and so marked has been the advance of 1913 and 1914 over previous years as to give reason for the greatest optimism for the future.

Chehalis River Temporary Bascule Bridge

Wooden-Truss Single-Track Span Operated without Counterweights by a Hoisting Engine and Single Six-Part Tackle


WOODEN-TRUSS TEMPORARY BASCULE SPAN AT MONTESANO, WASHINGTON

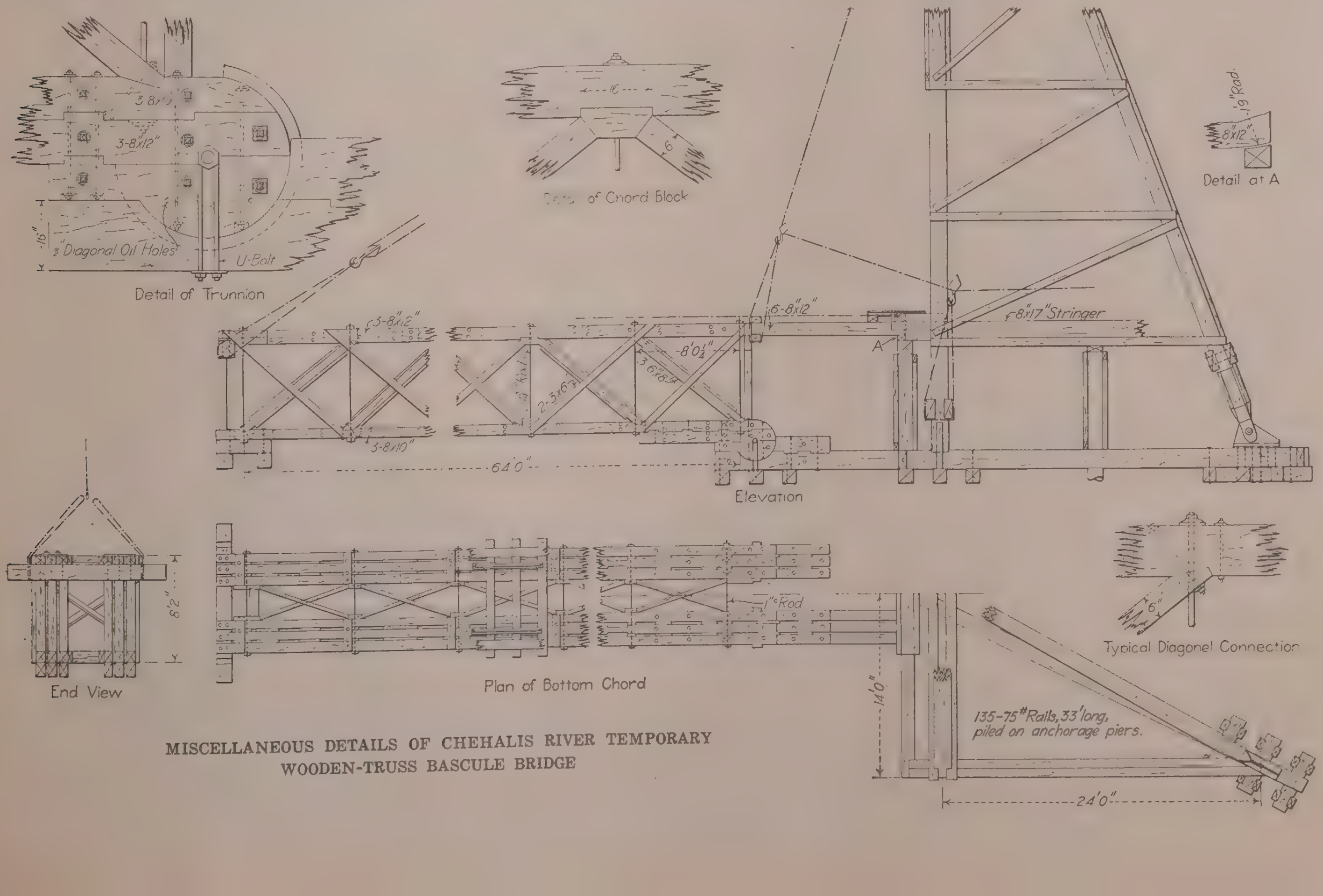
A CABLE - OPERATED single - track wooden-span bascule bridge erected by the Oregon-Washington Railroad & Navigation Company across the Chehalis River at Montesano, Wash., was built almost entirely of local material, was simple in design and successful in operation, and permitted construction trains to be run without interfering with navigation, while the permanent steel span was being built. The work was described by Samuel Murray, bridge engineer, in a paper published in the "Proceedings" of the Pacific Northwest Society of Engineers. These notes are taken from his paper.

In the absence of a suitable second-hand steel-girder span a wooden-truss deck span designed for a live load of 4200 lb. per foot was built and fitted with wooden trunnions, cut from 8 x 17-in. trestle stringers, and made in three leaves each to correspond with the three-piece bottom-chord sections. When they were lubricated with skid grease they operated well under the working load of 55 lb. per square inch pressure. They were provided with 2-in. center pins, each anchored to the bearing block and pier timbers by a 1-in. U-bolt at each end. The bridge was operated by a single six-part tackle rove with ⅞-in. plowsteel and attached to the top of a triangular wooden tower, keyed to the foundation piles with fir keys and counterbalanced by rail piles at the rear.

Clearance for the revolution of the top chords at the heel of the bridge was provided by a movable end panel of approach stringers. These had a slightly concave bearing at the tower end and at the bascule end were attached by slings to a snatch-block in the bight of the fall lines from the operating tackle. This part of the line had, when the bridge was closed, a slack sufficient to permit the stringers to lie horizontally. When the hoisting engine was operated and took up the slack the stringers were revolved out of the way of the top chords before the tackle began to raise the bascule, and in lowering the latter the operations were reversed, the span coming to rest before the stringers were lowered to position.

The capacity of the available engine was sufficient to operate the bascule without counterweights, and the cost of the counterweight would have been greater than any saving effected by securing a smaller hoisting engine. Traffic was carried over the bridge while the permanent 250-ft. steel-truss swing span was being built at right angles to it, one panel of stringers being temporarily omitted to give vertical clearance. After the completion of the new span the old span was removed by cutting away the pier and lowering the outboard end of the span into the river during a flood. It was carried away and later recovered and put into storage.

TESTS OF SLUDGE from sewage-treatment plants, especially where two-story tanks and separate sludge digestion tanks are in use, are of great value in controlling the operation of the works. The reaction test, according to the American Public Health Association's committee report on sewage-works operation, is particularly important as an aid in detecting the cause of and pointing out the remedy for poor sludge production. It has been found that tanks producing bad sludge can be made to produce good sludge by adjusting the reaction from acid to alkaline.



MISCELLANEOUS DETAILS OF CHEHALIS RIVER TEMPORARY WOODEN-TRUSS BASCULE BRIDGE

TRAVELERS ON COLUMNS HANDLED RECORD YARDAGE OF CONCRETE

Electrically Operated Contractor's Plant for Building Kensico Dam

Experience with Alternating Current on $8,000,000 Contract of Catskill Aqueduct and Data on Costs, Power Consumption and Load Factor

By A. W. CARROLL

Mechanical Engineer, Barclay, Parsons & Klapp, Consulting Engineer, New York

ALTERNATING current, purchased at 1¾ cents per kilowatt-hour, was the form of power selected for operating the contractor's plant on the $8,000,000 Kensico dam of New York's Catskill aqueduct at Valhalla, N. Y., where the record volume of 65,290 cu. yd. of concrete masonry has been placed in a single month of twenty-four 8-hr. working days. The contract, which is being executed by H. S. Kerbaugh, Inc., of Philadelphia, for the Board of Water Supply of New York City, under the general direction of J. Waldo Smith, chief engineer, involves 900,000 cu. yd. of concrete, exclusive of 65,000 cu. yd. of molded concrete facing blocks and 30,000 cu. yd. of stone facing, 900,000 cu. yd. of excavation and 1,000,000 cu. yd. for backfill. These are the largest items.

Obviously the plant required to handle a project of this size must be on a huge scale. The equipment includes sixty rock drills, sixteen locomotive cranes, ten concrete mixers of various sizes, 110 concrete buckets, two 15-ton cableways of 2000-ft. span, thirty-four 22-ton electric derricks, twenty-five air pumps and an electrically operated rock-crushing plant with a capacity of 2400 tons of stone per 8 hr.

It was estimated that the time required to complete the project would be fully eight years, but owing to the tremendous speed obtained in the past year, when all records, except those at Panama, were broken for placing concrete in an 8-hr. day, at least two years of this estimated time will undoubtedly be saved. It is unquestionably due largely to the use of electricity applied directly to the work that has helped to so shorten this time.

Table 1—Power with Direct and Indirect Application of Electricity

	Electric operation, kw.-hr.	Air operation, kw.-hr.
Hoists	65,860	215,500
Pumps	14,105	53,100
Drills	9,882	44,400
	89,047	313,000
Kilowatt-hours for air operation in excess of electrical operation		223,953

Table 2—Operating, Load and Capacity Factors in Per Cent

	Operating factor	Load factor	Capacity factor
Hoists	58.2	13.41	7.81
Small drills	17.0	25.1	4.27
Wagon drills	50.0	28.45	14.28
Cableways	50.0	7.55	3.78
Crusher machinery	97.2	22.05	21.5
Conveyors	96.4	57.9	55.8
Concrete mixers	33.3	76.5	25.5
Air compressors	....	59.9	.....
Pumps	....	13.12	.....
Small motors	....	12.86	.....

Selection of Electric Current

After considerable thought it was decided to operate the construction plant, as far as possible, with electricity, and the firm of Barclay Parsons & Klapp was called upon to make a report as to its application. In studying the electrical plant operation the choice of the type of current was a vital factor. The well-known control of direct current and the general familiarity of the working public with it made it appear the more desirable installation. On the other hand, the great distances to transmit the large amounts of current and the consequent losses incurred by converting alternating current into direct current practically prohibited its use. Further, there was no public supply of direct current available. There was, however, at hand an immediate available source of alternating current, which was adopted for all purposes.

At the time this matter of choice of power came up none of the large electric companies or the various hoisting manufacturers felt in a very strong position to recommend alternating-current apparatus for universal use for operating hoists, cableways, etc. The experience, however, in the large marble quarries in Vermont and Maine with 20-ton alternating-current derricks and Temple electrically driven pulsating drills, corresponding to the proposed Valhalla equipment, warranted the recommendation of the system.

With these two large items of the usual contractor's plant capable of such operation, the solution of the problem became perfectly clear. The greatest saving to be expected by the use of electricity is made only when it is applied directly to the work to be done, as shown in Table 1 of actual power used as compared with an indirect application through an electrically driven air compressor.

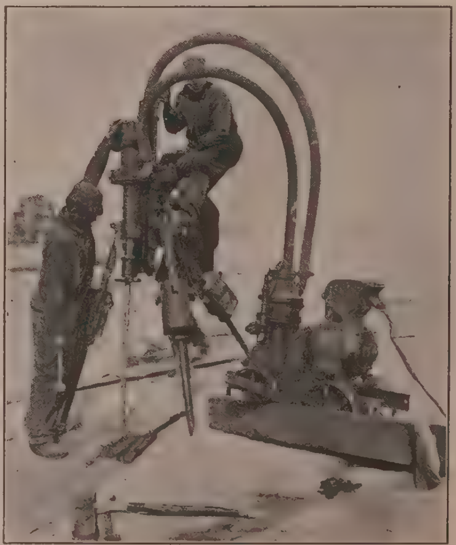
Power is supplied to the substation at Valhalla by the Yonkers Electric Light & Power Company, which installed originally a wooden-pole line carrying 13,200 volts, supplemented later by a steel-tower line, approximately 11 mi. long, carrying 39,600 volts, thus providing two independent lines guarding against interruptions.

The 2,300-volt, three-phase power is distributed through a nine-panel switchboard, each panel of which contains, besides the usual oil switch and relays, a watt-hour meter and a Bristol recording wattmeter. The latter instrument has proved of great assistance to the officer in charge, as the charts plainly show the comparison between work done from day to day and also give the time when the machinery was stopped or started, together with a general idea of the day's work. This was especially true in the case of the rock crusher and the air compressor plants.

Load Factor

In obtaining the load factor of the various machines some slight assumptions had to be made owing to the unavoidable fact that a few small machines would be placed temporarily on a circuit, the time of operation of which could not be accurately determined. It would seem advisable in laying out such a large plant as at Valhalla to install wattmeters on the individual machines, as they are not very expensive, and by their means more accurate record could be obtained. This question of load factor in estimating the amount of power required for a contractor's project is extremely important, and little data has been published on the subject.

It has become necessary in working up the results from the data of the Valhalla plant to adopt the following method in obtaining the load factor, or, more accurately, the capacity factor. The capacity factor is made up of two factors, the operating factor and the load factor. The operating factor represents the per cent of assigned equipment in actual service and the load factor represents the ratio of average load to maximum load. The capacity factor, being the product of these two factors, represents the ratio of average power to maximum power, should all the equipment be in serv-



ELECTRIC AIR DRILL AT QUARRY

GETTING DRILL HOLES READY FOR BIG SHOT AT QUARRY

ice at the same time. For example, it would be found that with thirty-four hoists on the work there will be an average of only 58.2 per cent of them in actual service, 41.8 per cent being out of service awaiting relocation, reconnection, repairs, or other delays. This 58.2 per cent is, therefore, the operating factor.

From actual results obtained it is found that the average load during any period for hoists in actual service is 13.41 per cent of the maximum load of the individual operating motor, which is the load factor, and was determined by dividing the actually measured kilowatt-hours by the total rated kilowatts of all the motors of the hoists in actual service, times the hours covered by the operating period. The product of this operating factor and load factor, then, gives the capacity factor which represents the average power requirements in percentage of total power of all hoists available on the work and not merely the hoists in actual service. This operating factor will be more applicable in cases where there are a large number of hoists or drills on the work. Where there are only two or three machines to be considered they would all probably be kept in service throughout the operating period.

Owing to the fact that it was necessary to start operation immediately and to provide against any possible failure of the electric apparatus, part of the work at the Valhalla plant is operated by two 1500-cu. ft. air compressors, electrically driven, the air being used for operating drills, pumps, hoists, blacksmith shop, etc.

Table 3 shows the number of kilowatt-hours required per unit of work.

These yearly average figures are obtained by dividing the total kilowatt-hours for each unit for the year by the total cubic yards of concrete placed during the year.

ELECTRICITY VS. COMPRESSED AIR

The remarkable simplicity and flexibility of an electric distribution system for contractor's work cannot well be duplicated by the cumbersome pipe lines required for air. The distribution at Valhalla is composed of 2300-volt, sixty-cycle, three-phase primary lines from the substation to a convenient place for the outdoor type step-down transformers and from there to the secondary connection to the individual machines. The plan adopted was to form a platform for supporting the transformers between two poles, the high-tension side being protected by a special outdoor type oil switch with no voltage and overload release. This has proved of ample protection between the substation and the machine. Thus there are no fuses to blow out and cause delays.

The uninsulated secondary bus wires are carried underneath the platform and Dossert connectors are used to connect the three single flexible weatherproof wires from the various motors to the buses, thus making a simple, cheap and quick connection. The secondary wires of the transformers are wound for either 244 or 488 volts, although all motors are wound for either 220 or 440 volts. The reason for the selection of this ratio of voltages was to take care of the drop in the secondary connection to the motors, as the starting torque for induction motors requires that full voltage be maintained to give satisfactory results, and besides the area of the conductors must be increased about 12 per cent above the usual practice. Owing to the fact that the feeders leading to the hoists, drills, etc., would be either lying on the ground or simply tied up to the first convenient support, it was deemed best to adopt 220 volts as a protection to the men, and so far not a man has been seriously injured, directly or indirectly, by electricity. Where a motor was to be set in a permanent position, 440 volts were used.

Neither the transformers nor the electric hoisting apparatus have any special protection against weather, and one of its chief operating advantages is that during the cold weather there are no delays caused by freezing pipes, blowing out of joints, and other grievances usually met with in air distribution, or the fact that licensed engineers would be required in many cases where boilers are installed.

It is remarkable how quickly plant can be shifted from one position to another with electrical connections. Enough slack cable was allowed at Valhalla, so that, for instance, at the dam the derricks were moved a number of times without even calling upon the electricians to make new connections.

A still further advantage which must be borne in mind in connection with electrical distribution is the resale value. The copper can usually be sold within 90 per cent of its original cost, and the transformers also at a high return. When it comes to the question of time required to install a wiring system against air system, the difference is greatly in favor of the electric.

With the present development of electrical machinery there are only few projects on which electricity could not be the sole source of power. Electrically driven rock drills of all sizes have been perfected. Derricks are

TABLE 3—KILOWATT-HOURS PER CUBIC YARD OF CONCRETE PLACED

	Quarry	Crusher	Air compressors	Excavation	Mixing and handling concrete	Water pumps	Machine shop	Lighting	Total
Dec. 25, 1912, to Jan. 24, 1913	......	......	......	......	....	.....	.....	.....	......
Feb.	......	......	......	......	....	.....	.....	.....	......
Mar.	41.2	116.9	342.2	107.3	3.70	82.95	12.3	17.64	724.2
Apr.	29.3	65.2	221.7	59.8	13.00	39.75	8.25	11.50	448.5
May	2.10	4.59	21.67	1.27	2.84	2.67	.41	.60	36.15
June	.79	1.89	7.45	.12	1.37	.75	.122	.168	12.66
July	.626	1.854	3.385	.233	1.18	.45	.076	.116	7.92
Aug.	.644	1.744	3.066	.282	.994	.423	.080	.107	7.34
Sept.	.645	1.340	3.425	.315	.827	.363	.090	.115	7.12
Oct.	.740	1.935	3.742	.404	.803	.425	.099	.162	8.31
Nov.	.614	1.705	3.365	.085	1.147	.396	.104	.164	7.58
Dec.	.785	1.973	3.800	.167	1.068	.451	.126	.200	8.57
Average for the year	.931	2.28	5.91	.743	1.11	.881	.161	.224	12.24

TABLE 4—SUMMARY OF POWER DISTRIBUTION AND FUEL CONSUMPTION
KILOWATT HOURS—PRIMARY

Month	Total cu. yd. concrete masonry and blocks placed	Quarry	Crusher	Air compressor	Excavation	Making & handling concrete	Water pumps	Machine shop	Lighting	Total primary kw.-hr.	Pounds coal used on all work
Dec. 25, 1912, to Jan. 24, 1913	......	18,200	30,460	129,200	39,600	......	34,600	4,160	3,780	260,000	1,133,810
Feb.	......	17,610	37,470	126,200	42,500	......	32,950	4,250	5,020	266,000	1,286,650
March	330	13,600	38,600	112,900	35,450	1,220	27,350	4,060	5,820	239,000	932,172
April	580	17,020	37,750	128,600	34,650	7,540	23,070	4,780	6,690	260,100	1,320,700
May	9,540	20,000	43,800	206,600	12,100	27,150	25,530	3,900	5,720	344,800	1,284,542
June	30,270	23,900	57,170	225,500	3,620	41,650	22,730	3,700	5,130	383,400	1,901,071
July	42,700	26,800	79,200	144,600	9,960	50,300	19,220	3,250	4,970	338,300	1,928,313
Aug.	49,400	31,800	86,200	151,200	13,900	49,080	20,880	3,940	5,300	362,300	1,402,650
Sept.	54,400	35,050	72,900	186,100	17,170	45,000	19,700	4,920	6,260	387,100	2,194,900
Oct.	45,400	33,560	87,800	169,800	18,310	36,400	19,280	4,490	7,360	377,000	2,447,242
Nov.	48,850	30,000	83,200	164,300	4,130	56,000	19,340	5,090	8,040	370,100	2,044,588
Dec.	38,800	30,450	76,600	147,300	6,500	41,400	17,520	4,880	7,750	332,400	2,159,988
Total	320,270	297,990	731,150	1,892,300	237,890	355,740	282,170	51,420	71,840	3,920,500	20,036,626

under as perfect control as any steam or air driven outfit. In most cases it requires a certain amount of air for blowing out the drillholes and sharpening the bits. This can be taken care of by a portable motor-driven compressor, which would not have to operate except when required for this purpose. Crushing and conveying plants make an ideal proposition for motor drive, the same being also true for the concrete mixers. The ease with which a motor can be put in out-of-the-way places and the amount of dirt and abuse it can stand allow the contractor to place his mixers at any convenient point.

Electric Shovel Cheaper to Operate

An electrically driven shovel, although the purchase cost is higher, can be operated for very much less than steam, especially when maintenance is taken into consideration and the cost of current is 2 cents per kilowatt-hour compared with coal at $4 per ton at the shovel. The most striking features of this electric shovel are the use of alternating current and the fact that the builders prefer alternating to direct. With the latest improvements in storage batteries, which require no skilled attention, or, if necessary, trolleys, the electric locomotive so equipped can do the same amount and variety of work and at a cost comparing favorably with a steam locomotive, although the first cost, as in the case of the steam shovel, would be somewhat higher.

An argument that might be brought against the universal use of electricity for a contractor would be that in moving around to different parts of the country he might land in a locality where the current differed in cycle and phase from what his plant was built for, or the cost of current might, if purchased, be prohibitive, and especially so if it would be necessary to convert this current to suit his machinery. The proper solution then is in the installation of his own electric turbo-units and condensers which would compare favorably with the cost of air compressors of proportional size for the work to be done. A plant of this type could be more cheaply and easily dismantled and moved from place to place than an air plant, as it requires much less piping, space, etc. A further saving would be made if the contractor was to have a standard layout for all his installations.

Comparative Costs

The question of cost is naturally of first importance to be considered in a plant of such magnitude as that at Valhalla. It was found the cost of electrical apparatus was slightly in excess of the cost of air, but the cost of operation, including interest, depreciation and maintenance, was about 29 per cent less, and this with purchased power in the neighborhood of 1¾ cents per kilowatt-hour. With power manufactured by the contractor the cost would be further reduced, as he would not have peak demand or other permanent operating charges to contend with as at Valhalla, when the plant was not in operation. A turbo-condensing plant such as suggested should be able to manufacture current at approximately 1¼ cents per kilowatt-hour with coal at $3.75 per ton delivered in the boiler room.

Fourteen Power Sites on the Deschutes River, according to a recently issued report of the U. S. Geological Survey, have undeveloped power totaling 304,000 brake-hp.

Excavating and Backfilling Sewer Trenches by Machine

Detailed Costs and Explanation of Method Used in Narrow Lanes and Business Streets in Vancouver, B. C.

Necessity for employing some advanced method of laying sewers in Vancouver, B. C., was first recognized several years ago when work in narrow lanes and busy streets was seriously hampered by lack of room for spoil banks. After considering several methods, a trenching machine was purchased, which has, after some slight changes to adapt it to conditions, been in continuous service for about three years. Although this machine is not considered economical for shallow trenches or for work in sparsely settled districts, the city has had sufficient sewer construction under way to keep the machine employed continually on work where the conditions were favorable to the best results.

Operation of the Machine

The machine is designed to be set up over a 340-ft. length of trench, from which excavated material is loaded directly into buckets, which elevate it, run back along the trench and dump it as backfill over pipe already in place. It is obvious that the pipe must be laid at the same rate as the excavation advances. The buckets are operated by cables running through carriers on an overhead rail, which is supported over the center line of the trench and 12 ft. above the surface of the ground by nineteen wooden trestles. Each trestle is mounted on two wheels, one on either side of the trench, which rest on the rails of an 8-ft.-gage track. This track carries the engine as well as the entire 340-ft.-length of framework, thus greatly facilitating moving ahead as work advances.

Excavation is carried on simultaneously in two 48-ft. lengths of the trench, a gang of six men working in each. The machine is equipped for handling six 1/5-cu. yd. buckets at a time, so that by keeping eighteen buckets on the job a set of empties is always left in the trench when full ones are removed, and the workmen need never wait while buckets are being dumped. Under this plan each man has an 8-ft. length of trench to work in, and fills his bucket independently of others. When loaded buckets are hoisted to the limiting position they are automatically locked to the carriers, which are then drawn along the overhead rail to the point where the fill is being made. Here the buckets are dumped separately by a lockman, who moves along the bucket line on a plank walk supported by the trestles. This lockman signals the engineer for each move, and is the only man required on the bucket line, the empty buckets being taken from the cables and full ones substituted by the workmen in the trench bottom. The work of taking down the machine, moving to another job and setting up again ordinarily requires three to four days' time with a crew of ten men. Thus with a haul of, say, 1 mile, the total cost of removing from one setup to another is about $170.

Canvas Troughs

When small trunk or lateral sewers were uncovered for any considerable length in excavating the trench temporary provision was formerly made by carrying the flow during construction in open wooden troughs fixed to the side of the trench. It was found, however, that, besides being expensive to handle and move, these flumes interfered with the work and caused frequent trouble which could be entirely eliminated by the use of closed canvas troughs. The latter were made by simply affixing eyelets to opposite edges of a strip of heavy canvas of any desired width up to 3 ft. Eyelets on both edges of the strip are then hung on the same set of spikes driven into the timpering on the side of the trench and placed, roughly, on a fairly steep grade. This type of trough is often strung for the full 340-ft. length of the trench, and the laterals encountered are connected to it by short lengths of similar tubing.

Timbering Methods

A considerable quantity of timbering is taken from job to job with the machine, breakage being replaced as required. It has been found, however, that with the system now in use the breakage is almost negligible. For all classes of soft material 1½ x 10-in. sheeting is used in 4-ft. lengths, and it has been found that this works to much better advantage than the longer sheeting, which would require driving. When the trench has reached a depth slightly over 4 ft. digging is stopped while the timbering is placed.

The diggers all help in placing the timbering, at least until the stringers are braced in by jacks, after which excavation is resumed, while the man detailed to look after the timbering sets the struts and lines up the timbers generally. This man spends all his time attending the timbering—carries it forward as fast as it is removed from the backfill and lays it along the trench where it will be needed in new excavation. Thus, when a new set of timbering is required, all material is ready to be passed down by the timberman, and as the workmen do not have to leave the trench, the entire operation of placing timbering in a 48-ft. section 4 ft. deep delays the work only about twenty minutes. One 3 x 12-in. stringer is placed midway of each sheeting set, and opposite stringers are braced by 4 x 4-in. struts, spaced on 8-ft. centers. When nearing the depth at which sheeting will no longer be required the sheeting is changed from 1½-in. to 1-in. material, which still further reduces initial cost and cost of handling.

Crew

Exclusive of supervision, seventeen men operate the machine. These include twelve pick-and-shovel men filling buckets in the trench, one lockman, one engineer, one timberman, one toolman and a straw boss. Only half of the superintendent's time is charged against the machine, as he ordinarily looks after two jobs. In addition to the machine crew, a gang of four men is used in laying sewer pipe. Whenever the pipe crew gets behind with its work some of the diggers are set to helping with the pipe or concrete; and, vice versa, when the pipe crew has extra time it is used in the trench ahead. Thus it is possible to equalize any deficiency in forces or to compensate for unforeseen difficulties in either branch of the work, a flexibility which is considered a great aid to efficiency.

COST DATA

In order to give a fair idea of actual capacity of the machine and the cost of operation, a typical case has been selected in which about 7700 cu. yd. were handled in a 2700-ft. trench excavated for a 2-ft. trunk sewer. This work was done in Granville Lane, Vancouver, which has a width of 20 ft. A start was made on the lower end of the trench, hand labor being used until a depth of about 8 ft. had been attained. The machine was then put in service and used until the job was finished. The maximum depth of the trench was about 26 ft. The trench has a top width of 4 ft., which was maintained until a depth of 12 ft. 6 in. was reached, below which no timbering was used, and the width gradually decreased to 3 ft. at the bottom. The work was begun in the fall of 1913 and continued without interruption, using one eight-hour shift. The average volume of excavation handled in eight hours was 45 cu. yd. A careful distribution of the costs on this work gives the results shown in the table.

COSTS OF EXCAVATION ON GRANVILLE LANE.

	Cost per cu. yd.
Labor (including superintendent and watchman)	$1.63
Hauling machine to the job (total, $88)	.0115
Erecting and taking down machine (total, $96)	.0125
Upkeep of plant	.0428
Running expenses	.1126
	$1.81
Depreciation of plant	0.04
Interest on cost of machine at 5 per cent.	.02
Total	$1.86

DISCUSSION OF TABLE

The last two items in the table are values assumed for the city of Vancouver, and might be quite different under other circumstances. The life of the machine was assumed at ten years, it being assumed that in city service it would last much longer than in ordinary contracting service, and 5 per cent is the rate at which the city secures money for such purchases. It should be noted that only one haulage charge is made in these figures. This is because the machine is kept busy continually by being moved from one job direct to another. In contractors' service, if the machine were returned to the storage yard after each job, the haulage item would be doubled. The labor item, which is so large a proportion of the total, is based on the following unit labor costs per hour for an eight-hour day: Pick-and-shovel men, 40 cents; timberman, 42½ cents; lockman, 42½ cents; steam engineer, 53⅛ cents; toolman, 37½ cents; straw boss, 42½ cents, and one-half superintendent's time, 62½ cents. "Upkeep of plant" includes ordinary wear and tear, as well as minor breakage, while "running expenses" includes coal, oil, water, timber, tool sharpening, etc. Two items which might have to be included under other circumstances are employer's liability insurance and excess spoil haulage—the latter in cases where excavation and fill could not be figured to balance.

The question of minimum trench depth at which the machine would be efficient has been worked out for Vancouver labor price as about 8 ft. for the usual case. However, if the job was comparatively short and the haul very long, a depth as great as 12 or 14 ft. might be the minimum. A feature that tends to make pick-and-shovel men efficient, or at least keep them all up to a uniform standard, is the fact that no one can do less than the others without having this known, since all six buckets come up at once; when one man is slower than the others he will still be working while the remainder of the crew wait. It is to be noted that in practice this generally works out so that after the first few days on a job there is remarkable uniformity in the time the men require for filling buckets.

The machine used in Vancouver was purchased early in 1911 for $5000, duty paid, and was made by the Carson Trench Machine Company, of Boston, Mass. F. L. Fellowes is city engineer of Vancouver, and all sewer work is done under the supervision of A. G. Dalzell, assistant city engineer.

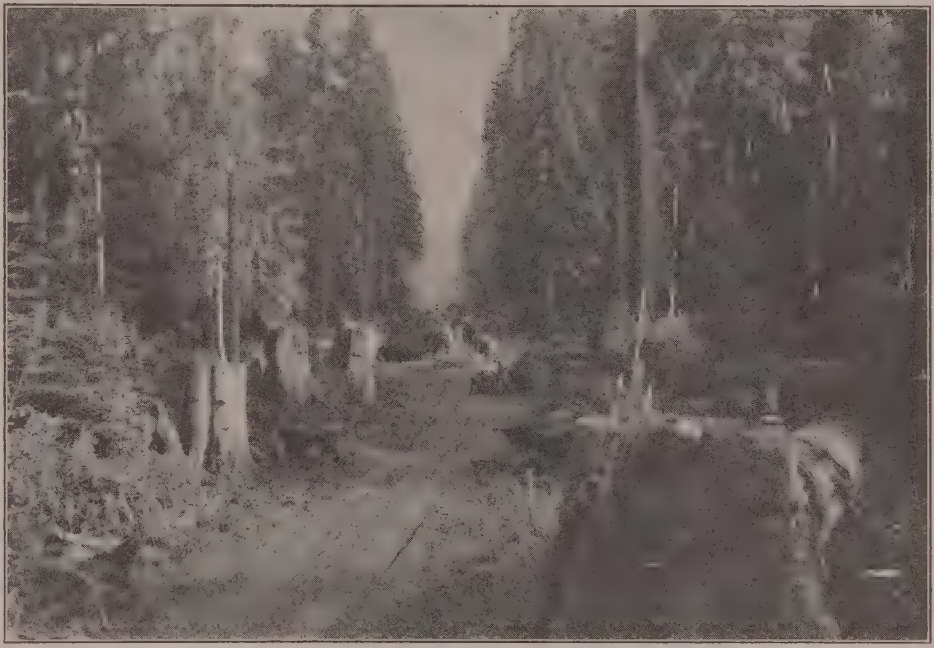
Duty Proposed on Lumber from United States to Australia

THE lumber industry in the Northwest has been actively interested in a proposed 10-per cent duty which British Columbia interests desire to have the government of New South Wales place upon lumber shipments from the United States. It is pointed out that the shipments of Oregon pine from Oregon, Washington and British Columbia to Austrialia have increased from 61,300,293 ft. b. m. in 1902 to 238,773,612 ft. b. m. in 1913, and that although British Columbia enjoyed 33 per cent of the trade in 1902, in 1913 she had only 4 per cent. In 1913 British Columbia coast mills cut 781,000,000 ft. b. m. and only shipped 46,000,000 ft. b. m. to all foreign countries combined. Lumber exports from the entire Northwest during 1913 totaled 600,000,000 ft. b. m., and were distributed as follows: Australia, 40 per cent; New Zealand, 1½ per cent; west coast of South America, 20 per cent; China and Japan, 21½ per cent; United Kingdom and Continent of Europe, 7½ per cent; South Africa, 3½ per cent; miscellaneous, 6 per cent.

Costly Highway Clearing in Dense Forests

On Certain Road Work in Oregon, Where Very Large Trees Are Encountered, Clearing and Grubbing Amounts to $3000 per Mile

IN RUNNING lines for the new State highway between Portland, Ore., and Astoria, the surveyors had to note the position of trees with as much care as rock excavation is measured in ordinary location surveys. The reason for this is made plain by the accompanying illustration. One of the 12-ft. stumps which was moved from the road shown required the use of 150 lb. of 40-per cent dynamite and occupied the workmen for a week. To get it out of the way cost at least $75, not including the expensive rock fill which had to be made in the hole it left.



ROADWAY CLEARED THROUGH DENSE FOREST OF LARGE TREES IN OREGON
Note size of stumps compared with automobile

The clearing cost on this work ranges from $100 to $200 per acre, and averages about $150, while the grubbing charge is kept down, by carefully locating the line between trees, to $1.50 per square rod. The width of slashing depends upon the amount of sun and wind that must be admitted to the road, and, therefore, indirectly upon the rainfall. Usually a 60-ft. right of way is slashed, but for the road shown in the illustration herewith a 40-ft. width was considered sufficient.

Clearing and grubbing from Portland toward the coast averages about $2000 per linear mile of road, and in some sections easily amounts to $3000 per mile. For the most part this is being built now as a good earth road, but later on it is intended to lay on it a 16-ft pavement.

This division of the Oregon State highway work is under the supervision of L. Griswold, assistant highway engineer.

TWO 1200-HP DIESEL ENGINES have been installed in two ocean-going torpedo-boat destroyers which will be launched before long on the Clyde River, Scotland, for the Japanese Government. These engines will be used on cruises only, as the use of oil permits a great saving of fuel. In addition the ships have twin steam turbines, each of 1200-hp capacity.

Coaling and Sanding Station on the Virginian Railway at Elmore

Reinforced-Concrete Structure with Crusher and Screen, Accommodating 200 Tons Each of Lump and Stoker Coal and 150 Tons of Green Sand

By F. F. HARRINGTON
Engineer of Structures, The Virginian Railway Company

A REINFORCED - CONCRETE coaling and sanding station, with screening and crushing facilities, bin capacity for 200 tons each of stoker coal and lump coal, and complete facilities for storing and drying sand, is a feature of the yard expansion recently completed on the Virginian Railway at Elmore, W. Va. The plant is electrically operated, with various safeguards against accident, and the layout is such that engines on four tracks can be supplied with both coal and sand, and coal cars on one track can be loaded for shipment to other points.

Elmore is 375 mi. from Norfolk. The grade between Elmore and Clarks Gap, a distance of 14 mi., known as Clarks Gap Hill, is the heaviest on the Virginian Railway, the maximum being 2.07 per cent, compensated for curvature, and the coal is transported up this grade in trains of from 60 to 70 cars of 50-ton capacity by three of the largest Mallet engines on the road. The long narrow yard is constructed on a bench in the hillsides where the tracks parallel the Guyandot River near the mouth of Barker Creek. Owing to the rapid growth of the coal business it was necessary to enlarge the yard and provide shop facilities which were completed the past year. A double track has also been constructed between Mullens and Taft, a distance of 5 mi., extending through the yard.

The shop facilities provided include a five-stall engine house with annex containing a machine shop, storeroom and wash room, a power station and an oil house, all of brick construction on concrete foundations; a reinforced-concrete ash pit 140 ft. long, a 200,000-gal. steel water tank, three water columns and the 400-ton reinforced-concrete coaling and sanding station. The buildings and yard are lighted by electricity, and a fire-protection system has been installed for the shop building. In order to make room for these improvements it was necessary to divert the Guyandot River and build in the bed of the old channel and on low ground adjacent thereto, which greatly increased the cost of the work. The shop facilities at Elmore are for light running repairs, the main shops being located at Princeton, W. Va., 35 mi. east of Elmore.

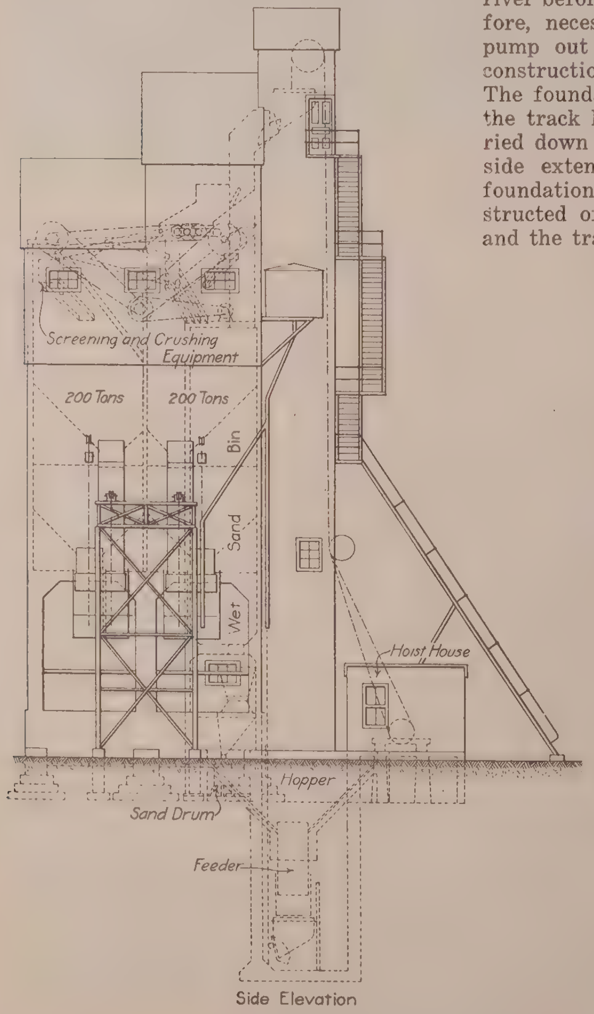
Description of Coaling Station

The 400-ton coaling and sanding station was constructed partly in the bed of the river before it was diverted. It was, therefore, necessary to build a cofferdam and pump out the water before starting the construction of the foundations and pits. The foundations on the river side and for the track hopper and bucket pit were carried down to solid rock; those on the land side extend down to firm ground. The foundations for the entire plant were constructed of plain and reinforced concrete, and the track hopper and bucket pit of reinforced concrete, all mixed in the proportion of one part of Portland cement, three parts of clean sharp sand and five of crushed stone small enough to pass a 1½-in. ring. The track hopper and bucket pit were made watertight below high water. Reinforced-concrete wrecking piers are provided the full width of the columns parallel with the tracks to a height of 5 ft. above the top of rail.

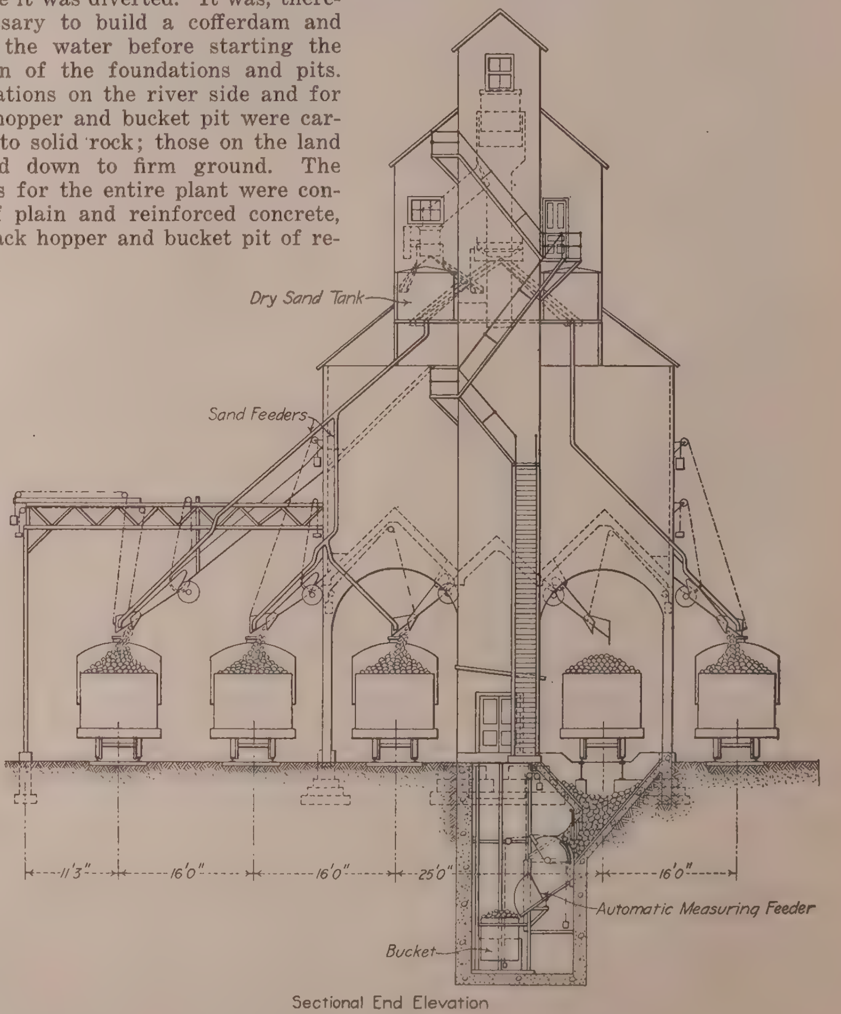
The reinforced concrete for the coal pockets, wet sand bin and hoist house was mixed in the proportion of one part Portland cement, two parts clean sharp sand and four parts crushed stone small enough to pass a ¾-in. ring. The inside surfaces of the pockets and receiving hopper were covered with neat cement, put on wet with the balance of the concrete so as to insure a homogeneous mass, and given a steel float finish so as to make them entirely self-clearing of coal. The inclosures over the coal pockets and the bucket tower from the top to the ground are constructed of structural steel covered with rust-resisting galvanized American ingot iron siding and roofing No. 18 gage. A steel stairway is provided for reaching the upper housing of the plant.

Two Kinds of Coal Handled

The coaling station is provided with screening and crushing facilities for making stoker and lump coal. There are two 200-ton storage pockets, each extending the full width of the coaling station, one for stoker coal and the other for lump coal. Both kinds are delivered on four tracks for coaling locomotives, and on the receiving track for shipment to other points. The



Side Elevation



Sectional End Elevation

ELEVATION SHOWING GENERAL ARRANGEMENT OF ELMORE COALING AND SANDING STATION coaling tracks are the two main-line tracks, the switching track and the outside run-around track. Provision is made in the pockets so that either stoker coal or lump coal can be delivered to the outside main track in case the pockets are not entirely filled with coal. This is accomplished by the construction of shelf pockets in the top and on the main-track side of the 200-ton pockets. The coaling gates are of the rack-and-pinion undercut type operated with chains from elevated platforms, except those of the westbound main track, which are undercut gates operated by levers from the tenders of locomotives.

The coal is elevated with a 2½-ton Holmen type counterbalanced bucket, having an elevating capacity of 75 tons per hour. The reversible hoist is located in the hoist house at the side of the tower and is equipped with cut-steel silent herringbone gears. The hoist is manufactured with heavy I-beam base bolted to concrete foundations and is direct connected to one 25-hp direct-current General Electric motor. The motor is complete with solenoid brake to prevent the dropping of the bucket in case the current is cut off. The bucket is equipped with automatic control apparatus of the Cutler-Hammer make, which consists of an automatic motor controller located in the hoist house, operated by four hatchway limit switches located near the top of the hatchway, two of these switches being actuated by the balance weights and two by the coal bucket. These limit switches and solenoid brake automatically stop the motor at the bucket discharge point on each trip, preventing any possibility of overwinding the bucket on the sheaves.

OPERATION

Run-of-mine coal is dumped into the track hopper, where it flows by gravity into a Schraeder automatic measuring feeder. This machine measures the desired amount of coal and discharges it automatically into the Holmen bucket. The feeder is rotated and emptied by the ascent and descent of the Holmen bucket, preventing any possibility of overflowing the bucket or flooding the pit.

The bucket is elevated automatically to the top of the tower and discharges into an equalizing hopper, from which it is fed by an apron feeder to the shaking screen. All the coal passing through the 1½-in. round perforations in the shaking screen flows by gravity into the pocket for stoker coal. The coal passing over the end of the shaker screen which does not go through the perforations flows by gravity into a 200-ton concrete pocket. Both of these kinds of coal are delivered on four tracks for coaling locomotives and on the receiving track for shipment to other points as previously stated.

If the screening process above described does not give sufficient stoker coal, the run-of-mine coal discharged from the Holmen bucket may be diverted to a 30 x 30-in. Jeffrey single-roll crusher, the rolls operating at a speed of 50 ft. per minute. This crusher is of sufficient capacity to crush all the coal elevated into stoker size. It then passes into the stoker pocket.

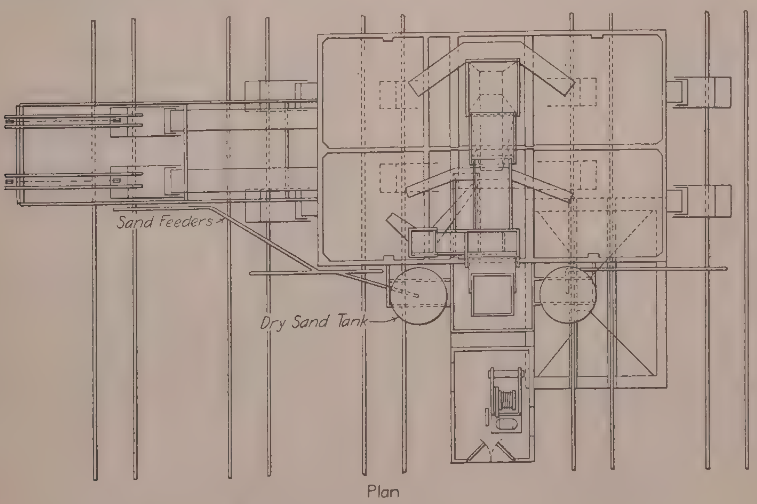
The plant is so designed that if the apron feeder, the shaking screen and the coal crusher are disabled, or if they are not needed, either stoker coal, lump coal or run-of-mine coal can be elevated and discharged direct into either of the 200-ton pockets as desired.

HANDLING OF SAND

The green sand is dumped into the concrete receiving hopper and handled in the same manner as the coal through the measuring feeder and the Holmen bucket, and is discharged into a reinforced-concrete green-sand storage bin having a capacity of 150 tons. The green sand from this bin flows by gravity to a standard coal-burning sand dryer, whence the dry sand drops upon an inclined screen where foreign matter is eliminated. The dry sand dropping through the meshes in the screen passes to a standard sand drum from which it is elevated by compressed air to two steel dry storage tanks, each of 10 tons capacity. The dry sand then flows by gravity through 3½-in. discharge pipes to moisture-proof undercut sand valves, complete with telescopic spouts for sanding locomotives on four tracks.

The apron feeder, shaking screen and single-roll crusher are operated through belt and chain drives by a 25-hp General Electric motor. Walkways have been installed in the upper housing to make all screening, crushing and elevating machinery accessible to the operator. The stairways and walkways are equipped with steel railings and a steel ladder is installed in the bucket pit. A winch has been provided on the hoist motor for pulling cars on the receiving track if necessary.

The operation of the shaking screen and other machinery in the top of the coaling station does not cause appreciable vibration of the building.



PLAN OF NEW COALING AND SANDING STATION AT ELMORE

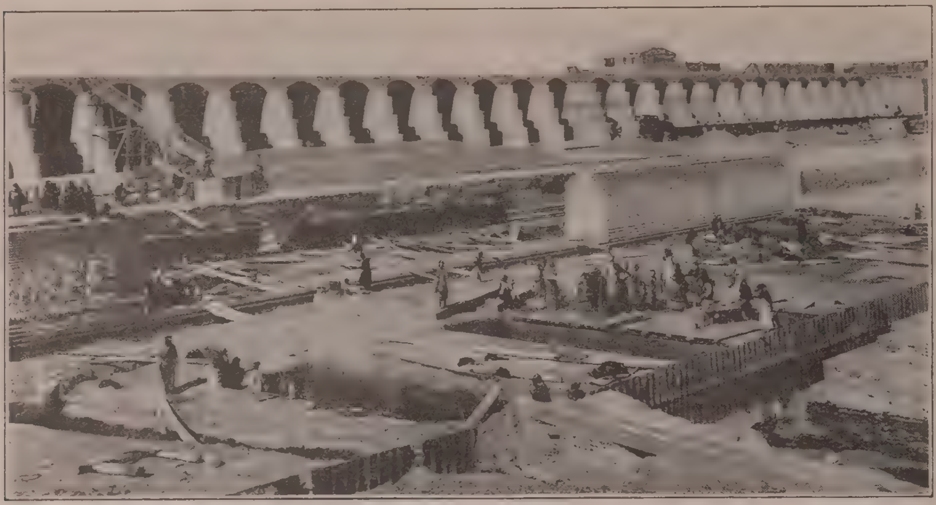
REINFORCED-CONCRETE COALING STATION

The plant was designed and constructed by the Roberts & Schaefer Company, of Chicago. Preliminary tests developed a number of defects which were remedied by the contractor, and the coaling station was placed in operation July 1, 1914. Stoker coal is only being used at present in the large Mallet engines on Clarks Gap Hill, but lump coal is being shipped to other points on the road. The cost of the coaling and sanding station complete was about $30,000.

Foreword of Good Roads Year Book for 1915

ROAD building statistics for the United States collected by the American Highway Association and soon to be published in the official Good Roads Year Book for 1915, show that more than 34,000 mi. of surfaced roads have been constructed during 1913 and 1914 and that during the 10-yr. period from 1904 to 1914 more than 96,000 mi. have been completed. In 1904 there were only 153,000 mi. of surfaced roads of all types in the United States. While the average mileage constructed per annum during the past 10 yr. is 9600, the total completed for 1914 exceeded 18,000. About 30,000 mi. of highway have been completed with the aid of State funds, of which over $200,000,000 have been expended. The State aid movement began in 1892 and has therefore continued for 22 yr. Only recently has it gotten well under way as the results accomplished for 1913 and 1914 comprise a total of 10,000 mi. of State aid highways completed, or in 2 yr. time one-third of the entire mileage constructed with the aid of State funds has been completed. Only six States now, out of a total of forty-eight, are without State highway departments and thirty States have granted actual money aid to the building of roads.

ROAD CONSTRUCTION along the Columbia River between Portland and the sea is costing about $1,000,000.



DOWNSTREAM VIEW OF HINDIA DAM, SHOWING SHEET PILING AND SECONDARY DAM

Hindia Dam on Euphrates River

Building Dam in the Dry and Then Changing Stream Bed by Excavating a New Channel and Constructing an Embankment Across the Old

THE Hindia dam on the Euphrates River in Asiatic Turkey is located 47 mi. south of Bagdad and is 815 ft. long. The designer is Sir William Willcocks, builder of the Assuan dam in Egypt, and the work is the first part of a $75,000,000 irrigation scheme that he prepared for the Turkish Government in 1909. The dam was described some time ago in the "Engineer," and the following is an abstract of that article. The method employed in building the dam was to place it east of the original river bed and construct it in the dry. When it was completed and the necessary excavation both upstream and downstream finished, the water of the river was brought to the dam by the demolition of the river bank and the erection of an embankment across the river in the position indicated on the accompanying plan.

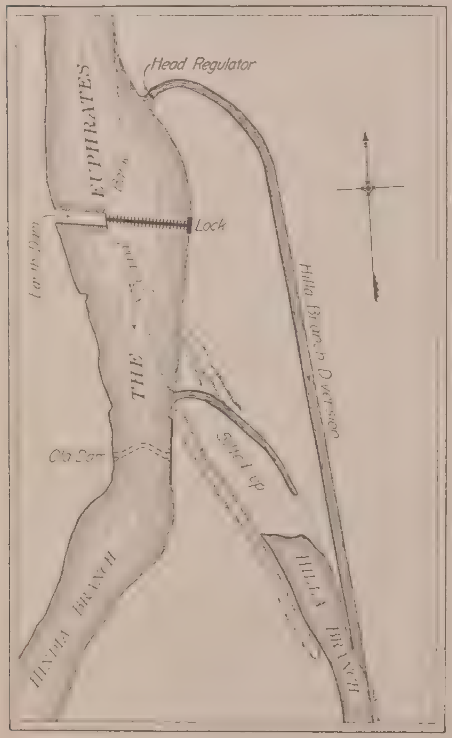
The ground on which the dam was erected consisted of fairly hard silt, dense enough to stand up vertically when excavated. It was not deemed necessary, therefore, to excavate the foundations to any great depth. As a matter of fact, under the dam itself the concrete was 3 ft. thick and 72 ft. 2 in. wide. These dimensions were maintained for the whole length of the masonry part of the dam, 779 ft. 2½ in. On this concrete brickwork was built to a depth of 6½ ft. and a width of 65 ft. 7 in. The top of the brickwork was set in cement and the rest in lime mortar. On this foundation the piers of the dam were constructed.

From the accompanying plan it will be seen that the whole area covered by the works was inclosed by interlocking sheet piling, and that there was a line of the same piling stretching from side to side of the pitching, arranged on the downstream side of the dam and nearly in the center of the breadth of this pitching. Upstream there is stone pitching for a width of 33 ft. This pitching is about 3 ft. deep, and is laid for most of this width on the clay puddle embracing the lower part of the upstream face of the brickwork of the foundation and the top part of the concrete beneath it, the clay puddle being taken out as far as the interlocking steel piling.

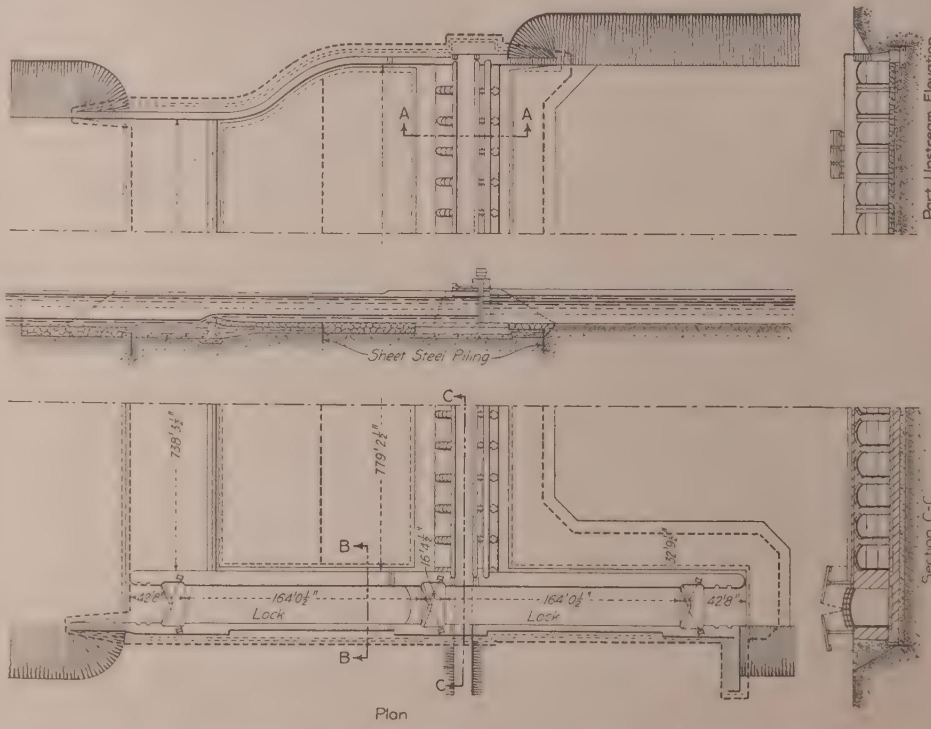
Below the dam the pitching is 6½ ft. thick for the first 65 ft. 7 in., and at this point comes the transverse line of sheet piling already mentioned. Beyond this again there is puddle at the bottom laid on the ground with pitching 3 ft. deep about it. This formation extends 72 ft. 2 in. to auxiliary dam or weir 8 ft. wide extending across the channel. As it approaches the weir the puddle is thickened out until it reaches the same depth as the weir itself. The latter is formed on a base of concrete, and downstream from it is a brickwork apron 3 ft. thick—the top half laid in cement and the lower half in lime mortar—carried on a foundation of concrete 3 ft. thick. About 6½ ft. from the downstream toe of this concrete comes the line of interlocking steel piles, the heads of which reach to the top surface of the concrete. The width of this apron is 57 ft. 5 in. and below it comes a width of 65 ft. 7 in. of pitching, carried down to a depth of 6½ ft. The whole arrangement is made clear by the accompanying drawings.

DAM OPENINGS

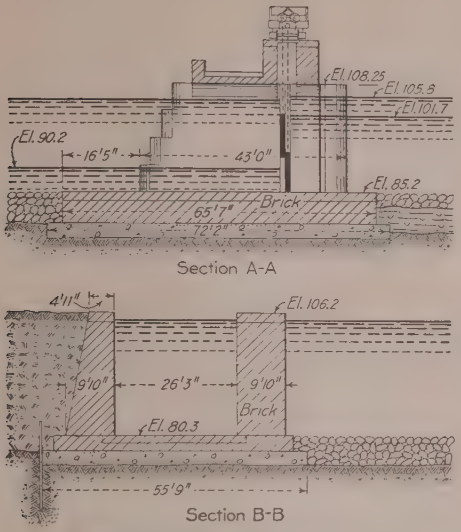
The dam itself has thirty-six openings, each 16 ft. 5 in. wide. All piers except the twelfth from each side have the same width, 5 ft., the two exceptions being 11½ ft. The piers are made of brick, with the upstream face vertical and the downstream face built with four steps, reducing the length from 43 ft. at the bottom to 36 ft. at the top, and are all joined at the top by brick arches, the height to the springing line being 19 ft. 8 in. The rise of the arch is 3 ft. 4 in. Above these arches there is a gangway 12 ft. wide extending across the dam, as well as two continuous



LOCATION OF HINDIA DAM IN MESOPOTAMIA



PLAN, ELEVATION AND SECTION OF DAM ACROSS THE EUPHRATES



CROSS SECTIONS OF DAM AND LOCK

walls, 9 ft. above the tops of the arches, for carrying the winch working the Stoney sluices. There are two sluice gates in each opening, each gate being 16½ ft. wide and 8¼ ft. high.

At one side of the dam a lock has been formed. It is 26 ft. 3 in. wide and nearly 350 ft. long, with a pair of gates in the middle dividing it into two parts, the effective length of each being 164 ft. ½ in. A double lift bridge provides a passageway across the lock, and it is arranged to come in a line with the bridge over the dam. The walls of the lock are 26 ft. 3 in. high and are constructed of brick laid in lime mortar except for the upper 18 in., where the bricks are laid in cement. The foundations are in general like those of the dam.

HEAD REGULATOR

The Hilla head regulator is similar in general construction to the main dam, but it has only six openings, each 9 ft. 10 in. wide. It is provided with a navigable opening 26 ft. 3 in. wide. The main dam will raise the ordinary summer level of the river about 16 ft. 6 in. which will allow an ample supply of water to be diverted into the Hilla channel.

SPILLWAY OPENING WITH GATES IN POSITION

Until the main dam and the Hilla head regulator were completed no water was allowed to reach either structure. A new channel 815 ft. wide was excavated above and below the main dam, and a new dam was made across the original bed of the river, forcing the water to pass through the new channel. This dam was created by forming a series of long "sauages," as they were called locally, of brushwood. These were constructed on the bank and were then rolled into the river and sunk by weights, forming a foundation on which the earth dam could be built. The contractor has also cleared the Hilla channel of silt for a distance of 50 mi. and has made a connection 114 ft. wide from the new head regulator to this channel.

As previously stated, the designer of the structure was Sir William Willcocks. The contractor was Sir John Jackson, Ltd., whose chief engineer and representative in Mesopotamia was Arthur Whitley. The contractor's resident engineer in charge of the work was Percy Warbrick. The engineer-in-chief for the Turkish Government was M. Edmond Bechara.

Panama Tolls Pass $1,000,000 Mark

THE $1,000,000 mark in Panama Canal tolls was passed Nov. 18, according to the "Canal Record," and at the close of business Nov. 30 the total collections amounted to $1,135,205.01.

Collection of tolls began in May, 1914, with the starting of a traffic in barges, towed by canal tugs. This lasted until the opening of the canal to ocean-going vessels on Aug. 15. The following is a summary of the receipt of tolls, by months, to Dec. 1:

Prior to Aug. 15	$11,610.69
Aug. 15 to 31	88,401.80
Sept. 1 to 30	269,863.00
Oct. 1 to 31	378,087.12
Nov. 1 to 30	387,242.40
Total	$1,135,205.01

The transits of vessels during this period, with the totals of cargo carried, were, with reference to direction, from Pacific to Atlantic, or eastbound, and from Atlantic to Pacific, or westbound, as follows:

	Eastbound		Westbound		Total	
Month	Vessels	Cargo	Vessels	Cargo	Vessels	Cargo
Aug.	12	57,182	12	49,106	24	106,288
Sept.	30	186,776	27	135,262	57	322,038
Oct.	40	252,288	44	168,069	84	420,357
Nov.	38	242,291	54	206,510	92	448,801
Total	120	738,537	137	558,947	257	1,297,484

Of the total of 257 vessels, 227 were laden and 30 were in ballast, or by nature not cargo-carrying vessels.

As distributed over the principal routes on which the traffic through the canal is moving, the transits to Dec. 1 may be summarized as follows:

	No. vessels	Canal tonnage
Coastwise, eastbound	54	320,155
Coastwise, westbound	61	282,020
U. S. Pacific Coast to Europe	34	248,020
Europe to U. S. Pacific Coast	8	38,318
South America to U. S. and Europe	24	166,917
U. S. and Europe to South America	15	74,644
U. S. Atlantic Coast to Far East	24	148,207
Miscellaneous routings	7	19,203
Vessels without cargo	30	....
Total	257	1,297,484

Shear in Beams

Presentation of a General Formula and Its Reduction to Special Formulæ for the Common Simple Sections

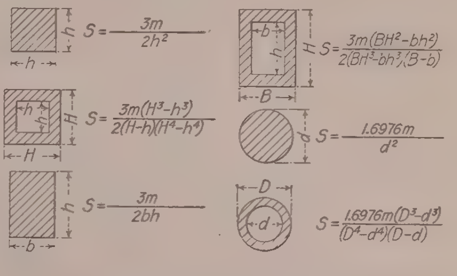
By ERNST JONSON
Engineer Inspector, New York Board of Water Supply

THE sheer in a beam is zero at the extreme fiber, increasing toward the neutral axis, where it reaches a maximum. Formulæ for finding the maximum shear are not given in the engineering handbooks or textbooks, although it is often of importance and should be determined.

The unit shear at the neutral axis is equal to the sum per unit of breadth of the increment fiber stress on one side of the neutral axis, that is, the fiber stress resulting from a moment equal to the total shear in a direction perpendicular to the axis of the beam. In other words

$$S = \frac{mM}{Ib}$$

where S = unit shear at neutral axis; m, total shear; M, moment around neutral axis of part of cross-section area lying on one side of neutral axis; b, breadth at neutral axis, and I, moment of inertia.


h
h
S = 3m / 2h²
b
h
H
B
S = 3m(BH² − bh²) / 2(BH³ − bh³)(B − b)
h
h
H
H
S = 3m(H³ − h³) / 2(H − h)(H⁴ − h⁴)
d
S = 1.6976m / d²
h
b
S = 3m / 2bh
D
d
S = 1.6976m(D³ − d³) / (D⁴ − d⁴)(D − d)

DIAGRAMS OF SIMPLE BEAM SECTIONS AND CORRESPONDING FORMULÆ

APPLICATION OF GENERAL FORMULA

This formula is practically true for all sections in which the breadth at the neutral axis does not materially exceed the average breadth. It should not be applied, for instance, to a solid square section with the neutral axis in the diagonal positions, and still less to a cross, for in these sections the shear varies not only in a direction perpendicular to the neutral axis but also along that axis. When worked out for the common simple sections the formula reduces to the respective expressions shown in the illustration.

Other sections may be figured by means of the general formula. For instance a built-up section would be figured thus:

$$S = \frac{m\ \Sigma\ Ag \text{ on one side of neutral axis}}{b\ \Sigma\ (I + Ag^2) \text{ on both sides of neutral axis}}$$

where A = area of plate or shape; g, distance of its center of gravity from the neutral axis; I, moment of inertia of plate or shape with reference to its own neutral axis, and b, total web thickness.

The shear at any point of the cross-section may be found by modifying the formula thus:

$$S_x = m\ (M - M_x)/Ib_x$$

where S_x and b_x are respectively the unit shear and the breadth at distance x from the neutral axis, and M_x is the moment around the neutral axis of the part of the cross-section lying between the neutral axis and the x line.

Test of Full-Size Reinforced-Concrete Bridge Slab

Determination at Arlington Experimental Farm of Stress Distribution and Other Phenomena in Slab under Various Loadings

A REINFORCED-CONCRETE slab of 16 ft. clear span, 32 ft. wide and 12 in. deep, has been subjected to a series of tests conducted by the U. S. Office of Public Roads at the Arlington Experimental Farm in Virginia. The data sought from these tests was as follows: (1) Distribution of stresses under one-point loading with loads of 10,000, 20,000, 25,000 and 30,000 lb.; (2) distribution of stresses under two-point loading with 40,000 and 80,000 lb.; (3) distribution of stresses under four-point loading with 100,000 lb.; (4) distribution of stresses under a one-point eccentric load of 40,000 lb.; (5) determination of the "effective width" of slab under single concentrated loads, and the law of the variation of stresses from the loading point (or maximum point) to the edges of the slab; (6) determination of "flow," or effect of time on growth and variation of stresses in the concrete; (7) effect of road coverings, fills or mats on the distribution of concentrated loads, and (8) effect of different methods of reinforcing (in future slabs).

DATA OBTAINED

In the tests described herein data have been obtained on the first six points. It is the intention to construct other slabs of similar area but varying in thickness, and in amount and arrangement of reinforcing. Later on full-size arches will also be tested.

The tested slab, which bears the research number 835, had a total depth of 12 in., or an effective depth of 10½ in. The reinforcing was approximately 0.75 per cent, and consisted of ¾-in. square steel bars spaced 7¼ in. on centers placed longitudinally, or perpendicularly to the supports. The yield point of the steel was about 33,000 lb. per square inch. There was no transverse reinforcing. The modulus of elasticity of the concrete six weeks old was 2,900,000, as determined from a cylinder 8 in. in diameter and 16 in. in height cast from the same mix as the slab. The aggregates were cement, 1-in. washed river gravel and bank sand, mixed in the proportions of 1:2:4. The date of casting the slab was June 26, 1914.

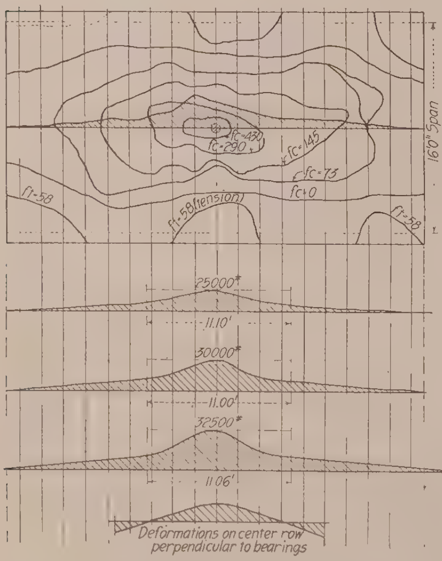


FIG. 1—CONCENTRATED LOAD AT ONE POINT

Plan shows curves of equal stress for a load of 30,000 lb. Diagrams show deformations on center line parallel with supports and effective widths of slab for different loads and deformations on center line perpendicular to supports.

The magnitude and distribution of the fiber stress (compression in this case) and the intensity of the fiber stress along the top elements of various cross sections are shown in the accompanying illustrations. The method of determining the effective width of a slab under a given method of loading is indicated in Fig. 1. The tendency of the concrete to "flow" under the action of a sustained load, and to restore itself to original conditions upon the removal of load is graphically shown in Fig. 5.

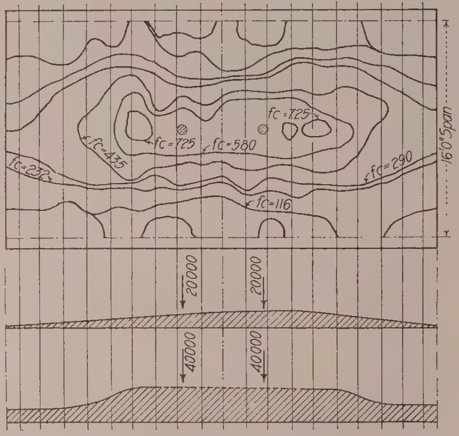


FIG. 2—CONCENTRATED LOADS AT TWO POINTS

Plan shows curves of equal stress for two loads of 40,000 lb. each. Diagrams show deformations on center line for different loads.

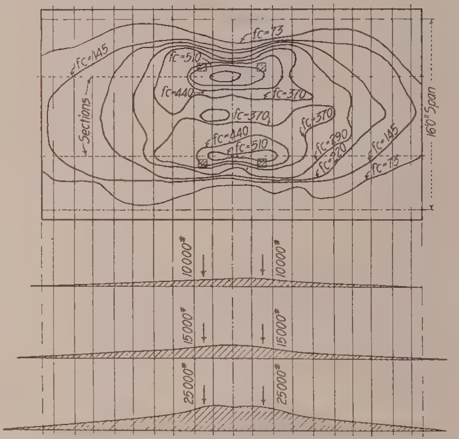


FIG. 3—CONCENTRATED LOADS AT FOUR POINTS

Plan shows curves of equal stress for four loads of 25,000 lb. each. Diagrams show average deformation on sections shown in plan. No effective widths taken.

Specific definitions of the "effective width," as mentioned in item 6, may be given as follows: (1) The width-value used in the design formulæ when computing the depth and reinforcement of a slab; (2) that width (or distance parallel to the supports) which, if given the same maximum fiber stress along the whole top (compression) fiber as is found under the load, will cause a total stress in this cross section equal to that for the whole span-width, when subjected to the same loading; or (3) that width of slab, which, if treated and designed as a simple beam, will sustain the given loading with the same maximum fiber stress equally and uniformly distributed, as the maximum fiber stress in the whole slab width which is not equally and uniformly distributed, but which decreases from the point of maximum stress to some small stress at the extreme edges of the slab.

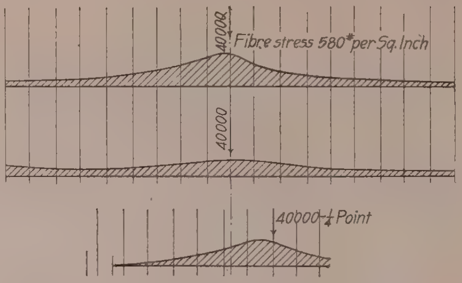


FIG. 4—ECCENTRIC LOADING OF SLAB

A load of 40,000 lb. was placed at the ¼ point. The upper diagram shows deformations on a line through the point of loading and parallel with the supports, the middle shows the deformations on the center line, while the lower shows the deformations on a section through the point of loading and perpendicular to the supports.

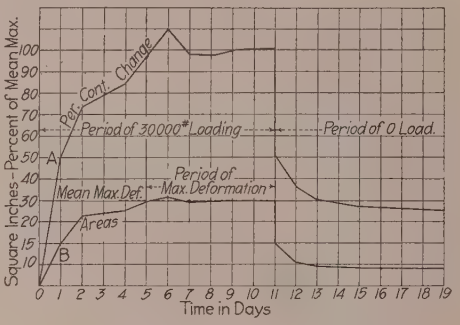


FIG. 5—THE "FLOW" OF CONCRETE

Curve A shows per cent change of deformation due to a sustained load of 30,000 lb. and O load. Curve B shows the integrated deformations due to a sustained load of 30,000 lb. and O load.

So far, the only method employed to determine the amount of deflection has been by the use of a wye level. It will be readily recognized that this method does not give readings of sufficient delicacy to justify attaching much importance to them.

The slab-testing equipment at the Arlington experimental farm, on which may be tested slabs of 16 ft. span and any width up to 32 ft. consists of two concrete piers 32 ft. long, 7 ft. high (4 ft. above ground) and 18 in. wide. Each pier is reinforced at the top with four 1-in. square bars. In the center of each pier is a U-bar of 2¼ in. square steel with a 4-in. steel pin at the top. Under these two pins are four 24-in. I-beams, which extend across the span of the piers in a horizontal position about 5 ft. above the pier faces. These I-beams serve to take the reaction of a 150-ton hydraulic jack placed on the slab and used for applying the load.

The intensity of the load is determined by the deflection of a chrome-nickel alloy steel beam as indicated on an Ames dial. The tests were made under the supervision of L. W. Page, director of the Office of Public Roads, U. S. Department of Agriculture.

NINE-FOOT ROADS are safer than those 12 or 13 ft. wide, in the opinion of A. R. Hirst, State highway engineer of Wisconsin, as expressed at the recent convention of the American Road Builders' Association. His reason is that the narrower road prohibits the dangerous practice of drivers trying to pass each other at breakneck speed in an inadequate space.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Dragline Excavates 70,854 Cubic Yards per Month

During September, 70,854 cu. yd. of material were excavated from the site of the clearwater reservoir at the Cleveland filtration plant, described on page 504 in the Engineering Record, Nov. 7. The finish excavation is 200 ft. wide at the bottom, 920 ft. long, 32 ft. deep at the high side and 15 ft. at the low side. A dragline was operated from the natural surface, thus eliminating any necessity for placing the hauling equipment at the finished grade. Four cuts were made by the machine, a Bucyrus class 14 dragline, equipped with a 60-ft. boom and a 2-yd. bucket loading two standard gage trains of seven 12-yd. Western dump cars hauled by Baldwin locomotives. According to the contractor's September records, the night crew worked twenty-seven 10-hr. shifts and three 11-hr. shifts. Work by the day crew was closed down two Sundays, on one of which the boilers were washed out. A third day was consumed in moving. Thus the machine averaged 123 cu. yd. per hour for the entire working time.

Lost time on every train was 4 min., due to the necessity of switching the loaded train in order to allow the empty one to clear. The best run of any one shift was 140 cars, each holding 12 yd., in 11 hr. with a total lost time of 90 min., 80 of which were taken up in waiting for cars and the remainder in coaling the engine. The excavated material, a hard blue clay on the bottom, overlaid with ashes and miscellaneous material, was hauled 1 mi. and deposited back of a breakwater.

The Fred R. Jones Company was the contractor for the excavation of the clearwater reservoir and the site of the filtration plant proper, both jobs aggregating 370,000 cu. yd. R. S. Jones is in charge of the construction of the filters.

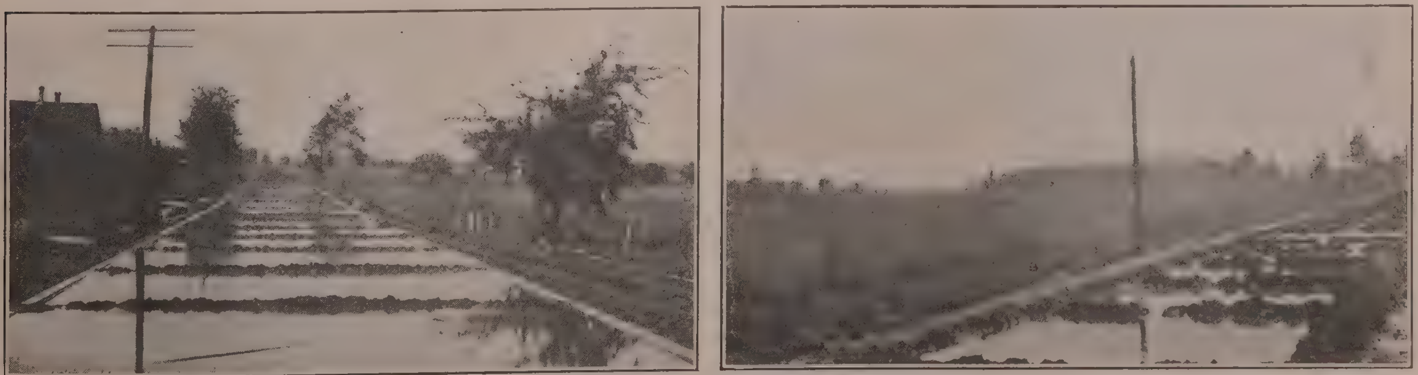
DRAGLINE OUTFIT WHICH MADE RECORD EXCAVATION AT CLEVELAND FILTERS

Curing Wisconsin Concrete Road Under Water

A state-aid concrete road lying between Neenah and Menasha, Wis., is beinng cured under water. The green concrete is covered for the first 10 or 12 hr. with canvas, by which time it has hardened enough to allow dirt dams to be constructed. These dams are placed on the sides, over joints and half way between joints. The intervening areas of pavement are then flooded to a depth of 2 in. over the center line and 3 in. over the sides. As part of the pavement is being built with a monolithic curb dams on the sides are unnecessary, the curbs serving to hold the water. The road is flooded for a period of from 10 to 14 days. The method is applicable only when the grades do not exceed 2 per cent, as otherwise the water can not be economically retained.

The work involved in the curing process is done by one man, who constructs the dams during the day; at night, when the water is not in demand at the mixer, he does the flooding. The same man also serves as a watchman in keeping the flooded areas to their original depth and in looking after the work during the absence of the other workmen on Saturday afternoons and Sundays.

The work is under the supervision of W. M. Conway, division engineer, reporting to A. R. Hirst, State highway engineer of Wisconsin.



VIEWS SHOWING CURING OF NEENAH-MENASHA CONCRETE ROAD UNDER WATER—WITH AND WITHOUT CURBS

Details of Record Tunneling at Rogers' Pass

A new American rock tunneling record—817 ft. in the 30 days from Nov. 1 to 30—was made in the Rogers' Pass tunnel of the Canadian Pacific Railway at Glacier, B. C., as announced in the Engineering Record of Dec. 19, page 659. The following additional information regarding the performance has been received from Foley Bros., Welch & Stewart, the contractors:

The heading, 7 ft. 6 in. x 10 ft. in section, was driven through slate, containing quartzite bands, by a gang consisting of 3 drill-runners, 2 drill helpers, 8 muckers, 1 trackman, 1 pumpman, and 1 walking foreman for two headings. The grade was a 1 per cent slope downward and the haulage was done by mules. A pump had to be placed at the face of the heading before dropping the drill bar for the lifter holes. This bar was 9 ft. 6 in. long and carried three Ingersoll-Rand water Leyner drills.

After the machine men had finished drilling the top holes of the heading and were waiting for the muck to be cleared away before dropping the bar to drill the lifter holes, they would oil their machines and connect up the air and water lines so that they could start drilling 1½ min. after the bar had been placed in its new position.

Shooting was done four times in 24 hours on 12 days, five times in 24 hours on 16 days, and six times in 24 hours on 2 days. The record round was 3 hr. 40 min. Two complete rounds were fired in 8 hr. on Nov. 27 and 28. The record day's work was 37 ft. on Nov. 27. The record week's work was 220 ft. from Nov. 23 to 29.

While the record of 817 ft. in a month was made in November that month contained only 30 days. Including Dec. 1 a record of 852 ft. was made for 31 days.

The following men were in charge of the work: A. C. Dennis, superintendent; J. Fowler, assistant superintendent; W. Fowler and J. Young, walking foremen; D. Hamer, J. Stewart and A. Adams, shift foremen.

Oxyacetylene Torch as Part of Contractor's Equipment

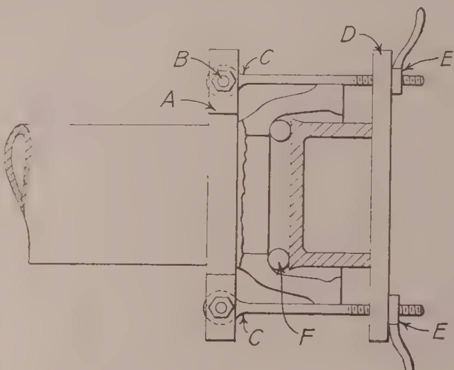
In erecting many of Chicago's large buildings the advisability of alterations on the job due either to errors in detailing, the use of party walls, or other causes, has led one of the large construction companies to add an oxyacetylene blowpipe to its regular equipment. In speaking of some of the uses to which the blowpipe is put, Avery Brundage, superintendent of construction for John Griffiths & Son, who are now building the new Morrison Hotel in Chicago, said: "Often the plans of existing buildings are either lost or mislaid. This means that in joining buildings, the beams of the old structure hit the columns of the new structure at various points. Where the beams extend beyond the column it is easy to measure the distance between the beams and insert a strut, or where the beam of the party wall just touches the column of the new building it can be tied in by angles and other steel shapes. To do this work quickly and at the least expense with second-hand material, the oxyacetylene torch is used.

"In this manner alterations are made in the field, whatever material is on hand may be utilized and the time that would be wasted in making measurements and drawings and obtaining new steel is eliminated. On the construction of the Marshall Field Building the Oxweld cutting blowpipe was kept on the work the entire time, and in building the new Morrison Hotel it has been kept on the job 75 per cent of the time."

MAKING FIELD ALTERATIONS WITH OXYACETYLENE TORCH

A Cheap Home-Made Plug for Testing Water Mains

In contracts for laying water mains it is customary to require the contractor to test the line for watertightness. A cheap home-made plug for such tests is described by W. E. Haseltine in the December "Journal" of the American Waterworks Association. The device consists of a clamp *A* (see drawing) surrounding the pipe directly back of the bell. Attached to the bolts which fasten this clamp together are eye bolts, *C*, with long threads. These eye bolts extend through holes in the bar, *D*, and are supplied with long threads to receive the wing nuts, *E*. A ring of ½ or ⅝-in. rainbow tubular manhole gasket, *F*, is put into the bell and against this is placed an ordinary cast-iron water main plug. The wing nuts, *E*, are then turned down, clamping this plug against the gasket by means of the bar, *D*.



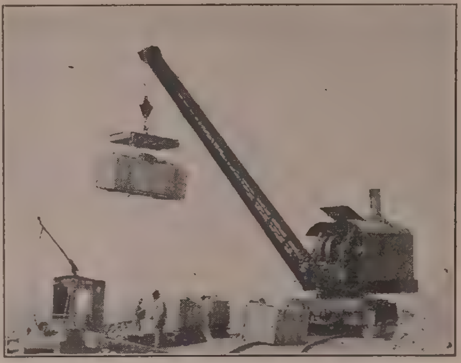
TEST PLUG FOR WATER MAINS

The entire adjustment can be made in a few minutes and the cost of the outfit is negligible. With the exception of the clamps, the same outfit can be employed for various sizes of pipe by having the bar, *D*, long enough for the largest size and drilling holes at various points in its length. This clamp has proved very satisfactory in service, according to Mr. Haseltine.

Locomotive Crane Handles Loaded Cars at Dump

Grant Park, Chicago, is being extended southward from land filled in with material from building excavations in the heart of the city. While much of the material is brought in by teams, the Chicago Warehouse & Terminal Company has extended the Illinois Tunnel to an elevator head-house in the park and through it raises loaded cars to the surface. It is common practice to puncture the tunnel and deliver spoil into it from the basements of buildings, thus eliminating any team haul whatsoever.

At the head-house are two lifts and from them the cars are dispatched in trains over industrial tracks to the dumping point where the 3½-yd. bodies are lifted by an Industrial crane locomotive and dumped at the desired point, the crane usually making a complete swing in so doing. About 375 cars per day in two twelve-hour shifts are handled either by Jeffrey electric motors or by a Baldwin gasoline engine.


CRANE HANDLES LOADED CARS

Additional unloading equipment has recently been installed in the way of an A-frame derrick with a 60-ft. boom operated by a second-hand Otis elevator hoist. It is the intention to move the derrick on rollers straight across the line of dumping to the northeast filling ahead of it, deadmen being buried in the filled material for this purpose.

Hydraulic Mining Cartridge for Breaking Rock

The hydraulic mining cartridge, as described by James Tonge in a paper before the Society of Engineers, London, differs from all other mechanical substituted for blasting. It is not operated on the principle of the wedge, and consequently the power expended in forcing a wedge into the hole is saved. Instead, the disrupting effect is obtained by a number of small rams or presses working at right angles from a strong cylinder of steel. The machines are made of various diameters, 2½, 3¼ and 4 in., and of various lengths, with eight, six or five rams, the smaller diameters having the larger number of rams. Pressures of 3, 4, or 5 tons per square inch are usual, so that machines must be made to withstand great stresses.

The cartridge is operated by a pump, to which it is connected by a pipe. It is desirable that the water, at the start, should be supplied in such quantities as to fill up quickly all the spaces within the rams and passages. When the rams begin to move and the pressure to increase, it should be possible for the operator to supply a less quantity of water, but at a greater pressure, to complete the final operations of the rams.

In practice it is found possible, according to Mr. Tonge, to arrange the hydraulic cartridge holes so as to enable much greater areas of material to be moved than could be done with a safe quantity of explosive, while in some cases the displacement has been extended by the use of small-sized boreholes toward which the slowly developing line of least resistance can assert itself. In other words, the power exerted by the rams can be controlled, after a little experience, so that the full pressure can be usefully applied.

In the Alexandra docks at Newport, England, and in the new dock at Swansea, England, the appliance has been used to break up ledges of rock in the vicinity of walls which would have been damaged by the use of explosives. The holes were put in and the cartridges inserted under water by divers, and the pump for applying the pressure was carried by a raft.

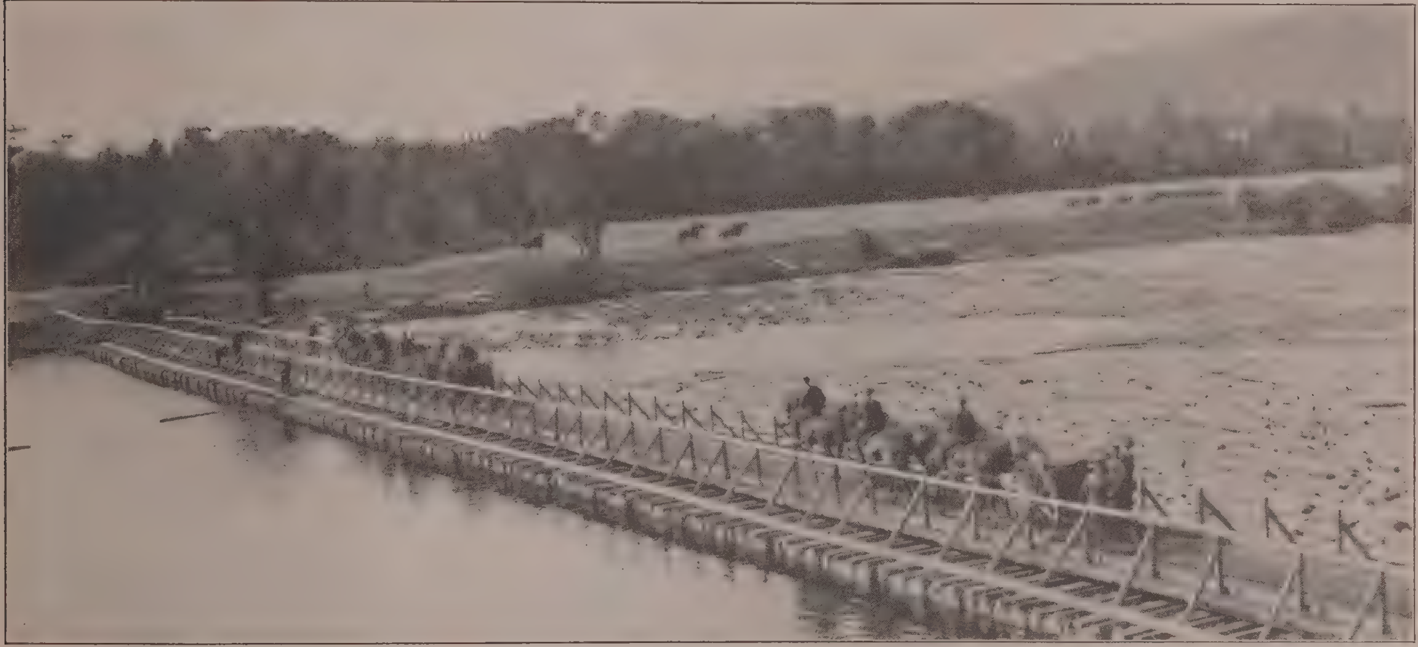
NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Heavy Pontoon Bridge Constructed in Record Time

Royal Canadian Engineers Build 350-Foot Bridge for Field Artillery in 4 Hours and 10 Minutes, Using 500 Oil Barrels

Valcartier, a sleepy little Irish village on a single line of the Canadian Northern Railway, was recently transformed in less than two weeks into an important railway terminal with 20 mi. of sidings and a population of 35,000. One of the items in the speedy construction work accomplished was the building of a pontoon bridge, shown in the accompanying illustration, to connect the main camp with the artillery practice grounds. Work was begun on the bridge, which is 350 ft. long, at eight o'clock in the morning, and at ten minutes after noon the commanding officer was able to hurry a heavy gun across the completed structure.



PONTOON BRIDGE AT VALCARTIER, 300 FEET LONG, BUILT BY CANADIAN ENGINEER TROOPS IN FOUR HOURS AND TEN MINUTES

About 500 oil barrels were used in the construction of the bridge, which is of the pontoon type. The work was done by 300 men divided into squads so that while one squad was making the barrels watertight another lashed them to heavy planks on which the superstructure rests, and still others carried the pontoons to the water's edge, floated them to position in the river or spiked down the superstructure.

Simultaneously with the construction of the bridge a 20-ft. bank was graded down to afford an easy approach for the roadway. The builders were hampered by the large quantity of logs that were being carried down with the current, and after the work was finished the log jam shown in the photograph formed on the upstream side, but no damage to the structure resulted.

The work was carried out by the Royal Canadian Engineers acting under the direction of Major W. B. Lindsay, of Winnipeg.

American Concrete Institute to Meet in February

The eleventh annual convention of the American Concrete Institute will be held in Chicago Feb. 9-12, 1915. Concrete road construction will be discussed on the first day, special attention to be given to costs, repairs and maintenance; tests and design on the second day, and the architectural applications of concrete on the third. A banquet will be held in the evening and on the concluding day of the convention plant management and costs will claim attention. It is expected that the details of this program will be arranged in a few weeks.

Alien Labor Suit Delays New York Subway Work

Pending a decision by the Court of Appeals as to the constitutionality of the alien labor clause in New York State contracts the Public Service Commission has announced that the opening of bids for the portion of the Broadway-Fourth Avenue Rapid Transit Railroad under Seventh Avenue from Fifty-first to Fifty-ninth Street, scheduled for Dec. 29, will be postponed. Until the alien labor case is settled and it is known definitely whether or not foreigners may be employed on city and State contracts it is probable that contractors would increase their bids considerably over those submitted in the past on account of the difference in cost between alien and native labor.

The taxpayers' suit on which the matter was raised was argued last week before the Appellate Division and it is expected that that court will hand down its judgment soon.

Dr. Berkey Custodian of Borings

In accordance with the plan for preserving records of borings suggested by the Society of Municipal Engineers of the City of New York, the Board of Estimate and Apportionment has appointed Dr. Charles P. Berkey, of the department of geology of Columbia University, to select and classify the subsurface specimens secured during preliminary investigations for building foundations, bridges, aqueducts, tunnels and subways in New York. It is believed that such a collection of borings, for which space will be provided in the American Museum of Natural History, will save the city a large part of the cost of preliminary investigation for subsurface work.

No Decision on Ohio Conservancy Case

Court of Appeals Adjourns without Ruling on Motion of Objectors for Dismissal of Suit

The Court of Appeals of Ohio adjourned before Christmas without rendering a decision on the motion by objectors to dismiss the conservancy case. The following notes will serve to indicate the present status of the controversy:

There are three courts in Ohio increasing in importance in the order named: Court of Common Pleas, Court of Appeals and the Supreme Court.

The conservancy case was begun in the Common Pleas Court in the form of a petition praying that the First Miami Conservancy District be established under the provisions of the Conservancy Act of Ohio enacted by the General Assembly in February, 1914. When this petition came up before the Common Pleas Court in March, 1914, the case was dismissed because the Conservancy Law required a vote of six judges out of ten, and the petitioners convinced only five, one being absent on account of illness. The ground upon which three out of the four negative votes was based was the unconstitutionality of the Conservancy Act.

There are two ways of going up from the Common Pleas Court to the Court of Appeals—first, by appeal, and second, by writ of error, depending upon the character of the case. The petitioners went to the Court of Appeals to reverse the action of the Common Pleas Court. The law gave them the right to appeal. They took the appeal, as directed by the law, and the appeal was sustained and upon the full argument the Court of Appeals held the law constitutional and ordered the Common Pleas Court, composed of ten judges, more commonly called the Conservancy Court, to reassemble and hear the case.

After counsel for the petitioners had taken their appeal from the Common Pleas Court they deemed it prudent to take the case up by writ of error also, as they had a right to do, thus having two cases pending to accomplish the same result. This second case—the writ of error case—has never been tried.

The objectors to the petition for the conservancy district took the ruling of the Court of Appeals, which was rendered last June, up to the Supreme Court. In that court the objectors made two points. First, that appeal was not the proper way to go up; second, that the law was not constitutional.

The Supreme Court on Dec. 15 held the law to be good but did not sustain the right of appeal, holding that the case was one which should have gone up by writ of error. The decision of the Court of Appeals was reversed for that reason alone—a matter of procedure only. However, as the counsel for the petitioners had the foresight to take their appeal from the Common Pleas Court to the Court of Appeals by both appeal and writ of error, and as the latter case has never been heard, the petitioners have been saved from being turned out of court on a technicality. As the case is now pending in the Court of Appeals the same questions in every way are presented in this new case as were presented in the "appeal" case last June, and as the Court of Appeals has already held the law valid and had its opinion confirmed by the Supreme Court, it is not likely to reach any different result. It is, therefore, more than probable that this court will again sustain the law, without fear of reversal by the Supreme Court, and will send down its order to the Conservancy Court, ordering it to reassemble and proceed to hear the case and take such action as the law provides. This may be heard in January unless the lawyers for the objectors are successful in forestalling action.

Plans for New Chicago Harbor Partially Completed

Park and harbor needs are said to be harmonized in a plan for the development of the South Shore in Chicago, which was submitted Dec. 23 to a subcommittee of the City Council committee on harbors, wharves and bridges. The plan was prepared by the Chicago Plan Commission after a meeting of all interests concerned. The subcommittee adopted the general plan and ordered the city law department to draw up ordinances carrying out the suggestions.

Before the Federal authorities will grant a permit for improving the shore between Grant and Jackson parks, the council must ratify the agreement between the Illinois Central Railroad and the South Park Board.

Unless the city indorses the main parts of the agreement, which have been approved by the courts, neither the railroad nor the park board can go ahead with any of the proposed improvement.

One of the main reasons for the War Department's opposition to a permit for parkway work is said to be that the city's rights toward future harbor development were not conserved. It is believed that in the new plan ample provision is made for almost unlimited harbor development.

Engineers' Club of St. Louis Offers Opportunities to Students

The Engineers' Club of St. Louis, recognizing the value of the services that engineers can give to engineering students and junior engineers, has proposed to encourage such students to identify themselves with professional organizations. To accomplish this the following program has been proposed: (1) To offer annually in each educational institution, participating in this agreement, a free associate membership, carrying with it remission of initiation fee and of dues for one year, to the student who presents the best paper before the technical society of which he is a member; (2) to invite the members of student technical societies to join excursions given under club auspices; (3) to suggest speakers who might be willing to address student societies; (4) to print in its May or June bulletin the names of members of student societies who desire to secure summer employment; (5) to print in its year book a list of the student societies and the names of their officers; (6) to offer members of student societies the privilege of junior membership at one-half of the usual rates for initiation fee and annual dues; (7) to participate annually in one joint meeting arranged by a student society, or group of coöperating societies; (8) to offer the facilities of its library to members of student societies in exchange for a similar privilege to its own members in available university libraries; and (9) to authorize the executive committee to make an appropriation from time to time (annually if the finances of the club will permit) for assisting in the prosecution of original research by a member of a student society.

Westinghouse Company Inaugurates Pension and Insurance Plan

The Westinghouse Electric & Manufacturing Company put into effect Jan. 1 a comprehensive system of insurance indemnity and pensions for its employees. First, for monthly premiums, paid at the option of each employee, the company will undertake to pay a proportion of the employee's wages during disability due to illness or accident not connected with the work. The expenses of this department are borne by the Westinghouse company, and the dues applied entirely to the benefit fund. Second, for disability caused by accident to the employee at his work, the Westinghouse company will pay for all medical attention, and will pay the employee two-thirds of his wages for total disability as long as disability lasts; and two-thirds of his loss of earning capacity for partial disability, as long as it lasts, even if the beneficiary should leave the employ of the company. For death due to accident while at work the employee's heirs or dependents will be paid $150 for funeral expenses and an additional sum as a pension. The fund for securing these payments is maintained by the Westinghouse company alone and all employees are compensated for accident by the company whether they belong to the relief department or not. Lastly, the Westinghouse company undertakes to pension at its expense all employees of 20 years' standing who reach the age of 70 years, or who may be retired by the company after reaching the age of 60 years, at rates based on previous earning capacity and length of employment, and varying from $20 to $100 per month. After the death of the pensioner, the company proposes to continue the pension to any wholly dependent child or grandchild at the rate of one-fourth the original pension for each such dependent, until he or she has reached the age of 16 years.

It is expected that in States having workmen's compensation acts, the Westinghouse company will be allowed to substitute this plan for the requirements of such acts, when the Westinghouse plan results in an increased benefit.

Hudson Vehicular Tunnel or Bridge Scheme Dead

The law passed by the New Jersey Legislature last winter for furthering the building of a bridge over the Hudson or a tunnel under the river is, according to the Newark "Evening News," a dead letter. The act called for the appointment of a commission by the Governor at the request of three or more contiguous counties, one of which borders on the river. Bergen is the only county that has made such a request. Strenuous efforts have been made to induce Essex, Hudson, Union and Passaic to join with Bergen, but they have been unsuccessful. Moreover, the canvass of the situation by the journal referred to indicates that there is no hope of securing sufficient backing to take advantage of the act.

The reasons for the apathy are the failure of the counties in question to see an adequate return from the structure and the suspicion that the scheme was chiefly in the interest of real estate speculators and special interests.

Skagway Wharf Destroyed by Fire

The complete destruction by fire of the 1000-ft. wharf at Skagway, Alaska, has just been reported by wireless. The loss is estimated at $210,000, of which $60,000 represents the value of the wharf; the warehouse and its contents accounting for the remainder. With the exception of the ore and bunker chutes all the structures on the wharf were gutted by the fire.

The destruction of the wharf will cause great inconvenience to shipping, it is reported, as this wharf was used for handling all the freight trans-shipped at this port for the interior over the White Pass and Yukon Railroad, or via the Yukon River. The wharf will be rebuilt, it is reported, but during its reconstruction shipping will be obliged to use an old wharf abandoned several years ago. The origin of the fire is unknown.

New Irrigation Company Organizes in Imperial Valley, Cal.

The Imperial-Laguna Water Company has been organized for the purpose of furnishing water to 150,000 acres of desert land between the new east highline canal and the sand hills near Yuma. The plan of the company is to build an entirely new water system, beginning at the Laguna lake north on the Colorado River. The main canal is to follow the lay of the land in a southwesterly direction, dipping into Mexico near Hanlon and following the sand hill line back into California.

Originally all the land to be affected by the new system was withdrawn from entry to come under the Laguna Project, which was proposed by the Imperial Irrigation District. Since that plan was abandoned the land has remained withdrawn, but it is reported that Secretary of the Interior Lane gave the new company assurance that the land would be opened for filing if the plan now proposed is shown to be feasible.

Officers of the new company are Mark Rose, president; W. F. Gillett, vice-president; C. D. Hartshorn, secretary-treasurer. Other directors are E. E. Bennett and E. E. Forrester.

Short Course in Highway Engineering at Michigan University

The department of engineering of the University of Michigan announces a short course in highway engineering for the benefit of engineers and commissioners, to be given during the week beginning Feb. 15. The faculty of instruction will be composed of members of the faculty of engineering of the university, members of the State Highway Department of Michigan and several outside lecturers. The announcement states that the course will be entirely free from commercialism.

Louisville to Be Mapped at a Cost of $30,000

It has been decided to appropriate about $10,000 a year for the next three years to pay for a topographical map of the city of Louisville, Ky. The program carries with it the most extensive form of city planning ever laid out for the city and was suggested by the Engineers' and Architects' Club.

Lectures in Economics for Engineering Students

Mr. James E. Allison, former chief engineer of the St. Louis Public Service Commission, has been appointed lecturer for the second term of the present year on economic subjects connected with public utilities. This course is for the senior engineering students of Washington University. It is also announced that Mr. Allison has established a fund to encourage the study of economics in relation to this field by engineering students at Washington University.

Sinking Shafts for Mill Creek Sewer at St. Louis

Shaft-sinking is progressing at St. Louis for the Mill Creek intercepting sewer tunnel described in a series of three articles in the Engineering Record of Oct. 3, 10 and 17. Each of the three contractors—Brocklehurst & Potter, of New York, the James T. McMahon Construction Company, of St. Louis, and Thomas Connor & Sons of St. Louis—is sinking two shafts, the deepest of which is 98 ft. All of the six shafts will be lined with concrete.

The construction plant includes six belt-driven two-stage Sullivan air compressors, five having a piston displacement of 1015 cu. ft. and one a displacement of 628 cu. ft. per minute. Electric motors furnish the power. Forty-six Sullivan rock drills with hollow steels and water jet attachment, are in use. These drills are of the type used in making the former American tunneling record of 810 ft. in 31 days at the Mount Royal tunnel of the Canadian Northern Railroad in Montreal. The Mill Creek sewer will have a finished section 16½ x 16½ ft. inside.

Concrete Institute Appoints Committee on Edison Fire

The American Concrete Institute has appointed a committee to make an investigation of the fire at the Edison factory, West Orange, N. J., to make necessary tests to determine the condition of the structures and prepare such reports as seem advisable. In this work the committee has been assured of the hearty co-operation of Mr. Edison and his co-workers. The committee is as follows: Chairman, Cass Gilbert, architect, New York; secretary, E. J. Moore, Turner Construction Company, New York City; Walter Cook, architect, New York; James Knox Taylor, architect, Washington; William H. Ham, engineer, Boston; Charles L. Norton, Massachusetts Institute of Technology, Boston, Mass.; Rudolph P. Miller, consulting engineer, New York City. Richard L. Humphrey, consulting engineer, Philadelphia, Pa.

The committee has already spent considerable time at West Orange and is planning to make a preliminary report in January. Later reports are to follow as fast as material is available.

New Station to Be Built at Pawtucket-Central Falls

A new station will be built by the New York, New Haven & Hartford Railroad to serve jointly the two cities of Pawtucket and Central Falls, R. I. As the tracks are in a deep cut at the site selected, the station will be of the overhead type. Two island platforms 900 ft. long, reached by stairways and elevators, will serve the four tracks. The new station is part of the grade-separation work that has been in progress in the two cities for about two years. The contract for the station has been let to Norcross Brothers, of Worcester, Mass. It is expected that the building will be ready for use about Aug. 15, 1915.

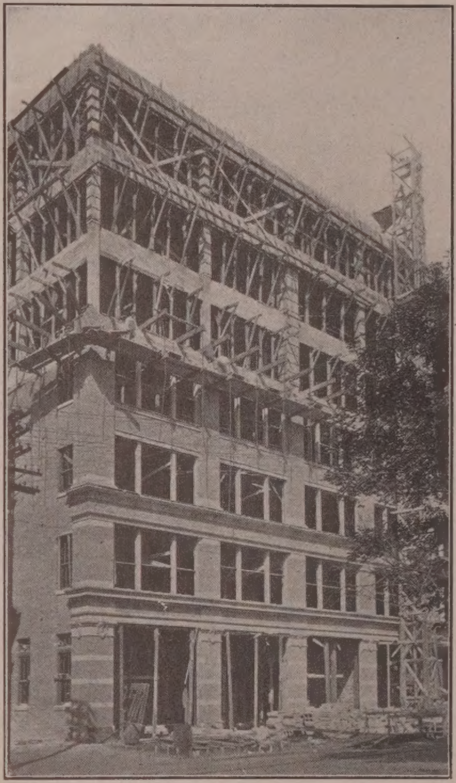
Contractors Eager to Bid on Navy Yard Building

It was announced in the New Construction Activities column of a recent issue that over 100 contractors had applied for plans and specifications for a new building to be constructed at the Navy Yard at Washington, D. C. Since the publication of this item the acting chief of the Bureau of Yards and Docks has informed the Engineering Record that 155 sets of plans and specifications have been forwarded to prospective bidders in accordance with their requests. The number of applications for these plans for the proposed general storehouse has greatly exceeded the demands for plans on any previous work. In the spring of 1912 a foundry building of similar construction for the same navy yard was advertised and only forty-five sets of plans and specifications were issued to applicants.

Stark-Lyman Building Reconstructed After Collapse

Work on the reconstruction of the reinforced concrete Stark-Lyman building at Cedar Rapids, Ia., which collapsed in November, 1913, was completed and the building occupied Oct. 1. The contract for rebuilding the structure was awarded last April to the J. C. Mardis Company, of Des Moines; from H. S. Starr of that firm the Engineering Record has received the following notes on the progress of the work:

"There was nothing particularly difficult about the rebuilding of the collapsed portion. There was practically a clean break at, or close to the edge of the beam for the entire height of the building. Nothing was damaged north of this line except one beam and a portion of a slab in the next bay at the second floor which had to be removed. One exterior column broken clear through at an angle of approximately 30 deg. to the horizontal just below the second floor. It is at this point that the system of truss rods advised by Mr. McCullough is particularly effective as it prevents any future failure due to bending in the column at this weak point.



RECONSTRUCTED STARK-LYMAN BUILDING

Removal of Débris

"We first investigated the masses of concrete left hanging from the reinforcing rods and made sure that there was no danger of any of them falling. The débris was then removed from the basement and forms built for the first floor, which was poured May 11. The ends of the wall girders and portions of the slab projecting beyond the edge of the beams at each level were cut off after the forms were built for that particular floor and concrete hanging from rods directly above was also removed at this time and lowered to the street. Reinforcing steel projecting from the old portion was cut off approximately 5 ft. from the edge of the beam and used as a tie for the old and new work. The concrete of the four columns at the edge of the break was cut off so as to expose the reinforcing steel and the columns were made approximately 8 in. larger all around. New vertical steel was added and wrapped with wire fencing.

"The original plans for reconstruction, by H. J. Bishop, contemplated a new beam alongside the old one to carry the new floor slab, but since Mr. McCullough's design was adopted a new beam was poured completely around the old one and made the full width of the new column. It was necessary to cut holes in the floor slab on the north side of the old beam so as to force concrete solidly up against ceiling. The portion of the old roof forms left standing were rebuilt and the roof poured June 30."

Propose More River Tunnels for New York Subways

On the recommendation of President McAneny of the Board of Aldermen the Board of Estimate and Apportionment of New York City authorized the transit committee to take up with the Public Service Commission the matter of building two new subway tunnels under the East River to provide for the subway traffic which was to have been carried over the Queensboro bridge. It is feared that this bridge, after the necessary alterations have been made to carry the subway lines, will not have the space needed for future street travel across it. Alterations to the bridge will cost $2,100,000, while the tubes can be built for $4,500,000. Part of the subway approach work to the Queensboro bridge is now under contract, but it is said that arrangements satisfactory to the city can be made with the contractor for abandoning this work in case the tubes are decided on.

Convention of Washington State Good Roads Association

The business session of the fifteenth annual convention of the Washington State Good Roads Association at Spokane, Nov. 19, elected Chas. I. McKenzie, of Colfax, Wash., president. Ellensburg was chosen for the convention in 1915. Vice-presidents elected were: Frank Terrace, Dr. W. C. Fox, E. N. Gillette, E. Rockery and J. C. Hubbell. F. J. Wilmer, of Whitman, was elected treasurer and Frank Guilbert, of Spokane, secretary.

The immediate inauguration in Washington and in every other commonwealth in the Union of a more definite system of road maintenance was favored. The convention urged the employment of experienced engineers only in all highway projects, and the continuation of the present road levies. The convention was attended by over 200 delegates from every county of the state and representatives of all county boards and city engineering departments.

Mid-West Cement Show

The ninth annual Mid-West Cement Show will be held at Omaha, Neb., March 2 to 6 under the auspices of the Mid-West Cement Users' Association. The convention of cement users, for which a program of papers already has been arranged, is scheduled for March 3, 4 and 5. Further information regarding the convention and show may be had from Frank Whipperman, secretary and treasurer, Twenty-eighth Avenue and Sahler Street, Omaha.

University of Illinois Has 1202 Engineering Students

The number of students registered in the College of Engineering of the University of Illinois on Nov. 1, was as follows: Architecture, 157; architectural engineering, 197; civil engineering, 201; electrical engineering, 277; mechanical engineering, 263; mining engineering, 41; municipal and sanitary engineering, 36; railway engineering, 30; total 1202. This statement does not include the number of engineering students registered in the Graduate School.

Industrial Exposition for American Made Products

To create a demand for goods manufactured in the United States a "Made-In-U. S. A." Industrial Exposition is to be held in the Grand Central Palace, New York City, March 6 to 13. This exposition is designed to show American made and American grown products in practically all branches of business and it is held at a time of the year when New York is the mecca of mercantile buyers from every section of the United States. This army of merchants is to be supplemented this year by a large number of South American and other foreign buyers who have heretofore gone to Europe at this same season.

The "Made in U. S. A." Industrial Exposition has been placed under the management of the National Exposition Company, of which Harry A. Cochrane, is president, with offices in the Fifth Avenue Building, New York.

Annual Meeting of National Chamber of Commerce

The annual meeting of the Chamber of Commerce of the United States of America will be held in Washington, Feb. 3, 4 and 5, 1915. Announcements of the meeting carry the statement that no sessions in the history of the chamber can begin to compare in interest with this one. The commercial upheaval created by the European war, the business legislation that has been enacted by Congress, the new problems involved in the development of the foreign trade of the country and the insistent demand for the upbuilding of American shipping in connection with the new opportunities for foreign trade present problems requiring careful consideration and discussion by the business interests of the entire nation. Committees of the chamber are now at work on important reports having a direct bearing on these and other conditions of business. These reports will be submitted at the February meeting.

Membership of British Concrete Institute

In his presidential address, Nov. 19, 1914, Prof. Henry Adams stated that the (British) Concrete Institute was in flourishing condition. He gave the present membership as follows: Honorary members, 16; ordinary members, 933; associate members, 27; associates, 6; students, 51; special subscribers, 5.

New York Central Merger Consummated

Consolidation of the Lake Shore & Michigan Southern Railway with New York Central & Hudson River Railroad was effected Dec. 22 at a meeting of the Lake Shore stockholders in Cleveland, when they ratified the action taken by the New York Central stockholders last July. The capital stock of the new company, which is to be known as the New York Central Railroad Company, is approximately $300,000,000.

Surplus Flow of Los Angeles Aqueduct for Irrigation

A bond issue of $2,606,000 was recently approved in San Fernando, Cal., by the remarkable vote of 738 for and 12 against the issue. The bonds are to provide for a distributing system for Owens River aqueduct water to be used in irrigation, and, although the issue is large in itself, the actual cost per acre is only $30.50. As pipes are to be laid every half mile, no point in the 85,545 arable acres within the valley will be more than ¼ mi. from a water main.

The formation of the new irrigation district No. 3 in Los Angeles County is the first step in carrying out the exhaustive plan of the Los Angeles water board for apportioning the surplus flow of the aqueduct. In addition it facilitates the annexation of this territory to the city of Los Angeles, which is also in accord with the plan of the water board, and as the population increases and the irrigated area is encroached upon, it is thought that the water consumption will not be radically changed.

Forty Foreign Nations Represented at Exposition

Forty foreign nations, and probably all the States and territories of the United States will be represented at the Panama-Pacific Exposition at San Francisco, which opens next month. In addition, many thousands of associations and other exhibitors will take part. Although England and Germany will not participate officially, many private concerns and associations from these countries will contribute exhibits.

First Waterworks Meeting in Iowa

The first meeting of waterworks men in the history of the State of Iowa was held Nov. 20 at the State University in Iowa City. About sixty representatives of waterworks utilities in various parts of the State were present. Among those who presented papers were Thomas H. McBride, president of the University; Prof. George F. Kay, State geologist; Dr. Henry Albert, State bacteriologist; Dr. Chas. S. Woods, professor of hygiene, and R. A. Stevenson, instructor in accounting. The chief interest, however, centered about the paper presented by John H. Dunlap, assistant professor of hydraulics and sanitary engineering in the State University. He told of his investigation of the waterworks plants in Iowa conducted last summer.

Los Angeles Wants Government Aid in Controlling Floods

At a meeting of the Los Angeles County board of flood control on Dec. 7 it was decided to ask the State of California to appropriate $1,000,000 to be used with local funds in carrying out a system of flood protection work throughout the county. It is reported that the board will also ask the Federal Government for aid, but plans in this direction have not yet been announced.

Following the damage done by the storm waters of last February a board of engineers was appointed, consisting of H. Hawgood, C. T. Leeds, J. B. Lippincott, F. H. Olmstead and J. W. Reagan, to report on means of controlling future floods. This body submitted a report early last summer recommending a comprehensive system for safeguarding waterways throughout the country, which was to cost about $9,500,000. On Sept. 22 the Board of Supervisors of Los Angeles appointed a committee of five, consisting of W. H. Booth, F. P. Flint, L. C. Gates, C. H. Windham and J. T. Lindley to ask State and Federal aid in the work recommended by the board of engineers.

To Consolidate Engineering Societies in Philadelphia

Engineers in Philadelphia are planning a consolidation of all technical organizations in that city into a single body to be known as the Engineers' Society of Philadelphia. It is intended that the present building of the Engineers' Club be made the headquarters of the new society. A committee has drafted bylaws and regulations which will be presented to each association for acceptance. One of the members of the organization committee is quoted as saying that the association will be of great benefit to the city. It will give the members of the profession a place where engineering subjects may be discussed and will make co-operation among engineers easy.

Contract Let for Government Grain Elevator at Vancouver, B. C.

The contract for the government elevator to be built at Vancouver, B. C., to handle the wheat of the prairie provinces, has been let to the firm of Barnett & McQueen for $690,000. The elevator will have a capacity of 1,250,000 bushels instead of 1,500,000, as was originally reported. It will be built of concrete and has been designed to permit of extension when the trade increases. The Canadian Government-owned system of handling grain now includes the Port Arthur elevator for grain going east, the proposed Vancouver elevator for Pacific trade, and three large interior elevators at Moose Jaw, Saskatoon and Calgary.

Short Course in Highway Engineering

The department of civil engineering of the University of Illinois announces that its second annual short course in highway engineering intended for township engineers and commissioners and contractors will be held Jan. 11 to 23. The co-operation of the State Highway Commission is assured and members of its technical staff will present papers and conduct laboratory demonstrations. As a rule the morning sessions will be devoted to technical papers, the afternoons to laboratory exercises in the mixing and testing of concrete and the examination of asphaltic materials and the evenings to semi-popular lectures. No exhibit of road making machinery will be held. There will be no charge of any kind for the course, which will be open to anyone without examination. Further information may be had from Ira O. Baker, professor of civil engineering, University of Illinois, Urbana, Ill.

Michigan Engineers to Hold Convention at Ann Arbor

The Michigan Engineering Society will hold its thirty-sixth annual meeting in Ann Arbor, Mich., Jan. 19 to 21. One of the principal features of the meeting is to be an address by Hon. Alfred Peakin, first prime minister of the Australian Commonwealth, who, it is hoped, will reach this country in time for the convention. He is making a trip around the world to bring to the attention of capitalists, business and professional men the opportunities of Australia. It is planned on the second day of the convention to hold a joint meeting with the Detroit Engineering Society. Some of the subjects upon which discussion has been arranged are legislation affecting engineering, control of water resources, road problems and kindred matters. Exhibits will be held in conjunction with the meeting, consisting of displays of engineering instruments and materials, by various manufacturers. S. J. Hoexter, Ann Arbor, Mich., is secretary of the society.

Short Course in Highway Engineering

A short course in highway engineering will be given at the State University of Kentucky under the direction of the Highway Engineering Department of the College of Civil Engineering Jan. 4 to 15. The purpose of the course is to help to advance the cause of good roads throughout Kentucky. There will be no charges made for the course.

Texas Association Holds Annual Meeting

The Texas Association of Members of the American Society of Civil Engineers held its annual meeting in Houston, Nov. 13 and 14. Sixty engineers attended the sessions. The following officers were elected for the ensuing year: President, John C. Hawley; first vice-president, C. H. Chamberlain; second vice-president, J. M. Howe; secretary-treasurer, J. M. Witt. The association was organized in Dallas, October, 1913, and the first semi-annual meeting was held last May in Austin.

Plans for French Pavilion Cabled to San Francisco

Details concerning the plans for the French building at the Panama-Pacific Exposition were cabled from France to San Francisco at an expense of $3000. The structure is to be a reproduction of the Legion of Honor building in Paris. It was designed by the commissioners in France, and instructions were wired to the resident directors in San Francisco on Dec. 14. Probably this long-distance transmission of designs is unique in the history of structural architecture.

Los Angeles May Have City Manager

Charter amendments have been presented to the city council of Los Angeles which provide for a city manager and a board of eleven directors in addition to the mayor and city council. A special election is to be called for Dec. 28 at which popular vote will decide whether the city manager plan is to be adopted. Under the proposed plan only the mayor and city council will be elected, the manager being appointed by the council, subject to the veto power of the mayor. The manager, in turn, would appoint the eleven directors, who will supersede various city commissions and have charge of the departments and who will be under civil service rules.

News of Engineering Societies

The Cornell Society of Civil Engineers will hold its annual meeting in New York City on Jan. 22.

The Oklahoma Society of Engineers held its annual meeting at Oklahoma City on Dec. 30. The society heard a number of addresses on engineering and allied subjects, which were followed by a general discussion of previously selected subjects.

The San Francisco Association of members of the American Society of Civil Engineers at its meeting on Dec. 18 elected the following officers for the ensuing year: President, A. M. Hunt; vice-president, M. C. Couchot; secretary, E. T. Thurston; treasurer, P. E. Harroun.

The Highway Engineering Society is the name of an organization recently formed by members of the Michigan State Highway Department. Bi-monthly meetings will be held. The officers of the society are: H. L. Brightman, president, and C. J. Neal, secretary and treasurer.

The American Institute of Consulting Engineers will hold its annual meeting at 55 West 44th Street, New York City, on Jan. 19. Three members of the council will be elected.

The Vancouver Branch of the Canadian Society of Civil Engineers was addressed at its meeting Dec. 17 by E. G. Matheson, who described the substructure of the Canadian-Pacific bridge over the Pitt River. The lecture was illustrated.

The Engineer's Club of Cincinnati held its annual meeting Dec. 18. The following officers were elected: President, Frank L. Raschig; vice-president, A. M. Wilson; secretary and treasurer, E. A. Gast, and directors, John T. Faig, E. H. Berry and O. F. Shephard. John T. Faig, Thomas Pushon and Clifford Stegner were appointed a committee to urge on the judges of the Superior Court that a civil engineer of railway experience be appointed to fill the vacancy on the board of trustees of the Cincinnati Southern Railroad, caused by the death of J. T. Carew.

The Highway Engineers Association of Missouri met Dec. 17-18 at Jefferson City, Mo., and proposed a legislative program for certain reforms in the State road laws. F. W. Buffum, State highway commissioner, and E. F. C. Harding and H. C. Allen, county highway engineers, were appointed to urge these reforms before the next legislature. The following officers were elected: President, E. F. C. Harding; vice-president, M. S. Murray; secretary, E. W. Sheets; treasurer, H. C. Allen. Hannibal, Mo., was selected as the meeting place for next year.

Personal Notes

A. H. Dimock, city engineer of Seattle, Wash., has been reappointed for a three-year term.

Lieut. Col. C. H. McKinstry, Corps of Engineers, has been granted one month's leave of absence.

George D. Williams, Guy Moulton and Frederick Williams have been appointed division engineers on the New York State Barge Canal.

H. M. Nabstedt has opened an office as consulting engineer at Carnelia, Ga. Mr. Nabstedt has been connected with the power development work at Tallulah Falls, Ga., in an engineering capacity.

H. H. Noble, founder of the Northern California Power Company, has resigned as its president and has been succeeded in that office by W. F. Detert. Mr. Noble has been elected chairman of the board of directors of the company.

A. J. Collet, director-general of the Department of Public Works of Santo Domingo, Dominican Republic, is visiting this country. He expects to stay at 2901 Hickory Street, Omaha, Neb., until Feb. 1, when he will return to Santo Domingo.

Anderson Polk has opened an office in New York City as consulting engineer. Mr. Polk was formerly with the Baltimore & Ohio Railroad as engineer on construction and maintenance, and with the Patterson-Sargent Company of Cleveland.

Col. George W. Goethals, Governor of the Canal Zone, arrived in New York on Dec. 23, accompanied by his wife, to spend the holidays with his son at West Point. This is the first Christmas Colonel Goethals has spent in the United States since 1906.

R. L. Fitzgerald, of Madison, Wis., has been appointed business manager of Winnetka, Ill., by Sherman M. Goble, the village president. Mr. Fitzgerald is a mechanical engineer. He was a member of the railroad commission of Wisconsin for some time.

S. A. Jordan, superintendent of the Baltimore & Ohio Railroad at Winchester, Va., has been appointed assistant superintendent of the Baltimore division, with headquarters at Brunswick, Md. Mr. Jordan was formerly located in Baltimore as district engineer of maintenance of way.

Richard Sachse has been appointed chief engineer of the California Railroad commission. Mr. Sachse has been acting chief engineer of the commission for the past year. He is a graduate of the Royal Technical Institute, of Dresden, Germany, and has done railway work in South Africa and the United States. He was for a time assistant engineer with the U. S. Reclamation Service and has been in charge of valuation work with the California commission since 1911.

H. E. Breed has been appointed terminal engineer of the State Barge Canal by State Engineer-elect Williams. Mr. Breed, after graduating from Colgate, and working as draftsman for the Newport News Shipbuilding and Drydock Company, was for ten years connected with the New York State Highway Department, in charge of road work, and as special investigator for the State engineer. In 1912 he went abroad to study inland waterway construction, and since that time has been engaged in private practice.

Charles M. Spofford, head of the department of civil and sanitary engineering at the Massachusetts Institute of Technology, has been named by President Maclaurin of that institute advisor to the city of Cambridge. Professor Spofford, together with Prof. C. J. Bullock, of Harvard, will advise the city of Cambridge on several important matters of administration. The appointments were made at the request of Mayor Good of Cambridge. Professor Spofford has had much practical and consulting experience, including connection with the determination of the strength of the Blackwells Island bridge, and the improvement of the Queque-chan River at Fall River, Mass. He has been Hayward Professor at the Institute for the past six years.

Obituary Notes

Lewis Eaton Smith, city engineer of Pasadena, Cal., died at that city on Dec. 18.

Richard J. Evans died Dec. 21 at New Orleans, aged 74 years. Mr. Evans, at the time of his death, was a member of the commission appointed to review plans for drainage and flood protection at New Orleans. He was formerly connected with the U. S. Coast and Geodetic Survey. Later he engaged in railroad work, having been chief engineer of the Memphis, Selma & Brunswick and Texas, Sabine Valley and Northwestern Railroads. Since 1898 he has been engaged on drainage, sewerage and water supply work at New Orleans.

Robert Bolling Eggleston, chief engineer of the White River levee board, died on Nov. 27 in his fifty-seventh year. Mr. Eggleston was a graduate of Sewanee University, and has been interested since 1877 in railroad, highway and levee work in the South. He was for some time chief engineer of the Plum Bayou levee board, also of Arkansas.

Civil Service Examinations

United States.—Examination to be held Feb. 2 is announced for sanitary engineer, $2500, open to men only. Graduation from a sanitary engineering course at a college or university of recognized standing, and at least 4 years' experience partly in anti-malarial work, and all in sanitary engineering, required. Applicants must be citizens of the United States under forty-five years old. Candidates will not be assembled for examination, but will be rated on education, experience and publications. Application should be made for forms 304 and 2095 to the U. S. Civil Service Commission, Washington, D. C.; the Secretary of the U. S. Civil Service Board, Post Office, Boston, Mass., Philadelphia, Pa., Atlanta, Ga., Cincinnati, Ohio, Chicago, Ill., St. Paul, Minn., Seattle, Wash., San Francisco, Cal.; Custom house, New York, N. Y.; New Orleans, La., Honolulu, Hawaii; Old Customhouse, St. Louis, Mo.; or to the chairman of the Porto Rican Civil Service Commission, San Juan, P. R. Applications, accompanied by medical certificate and other papers called for therein, must be filed with the Commission at Washington before the close of business on Feb. 2, 1915. County officers' certificate on the form need not be executed.

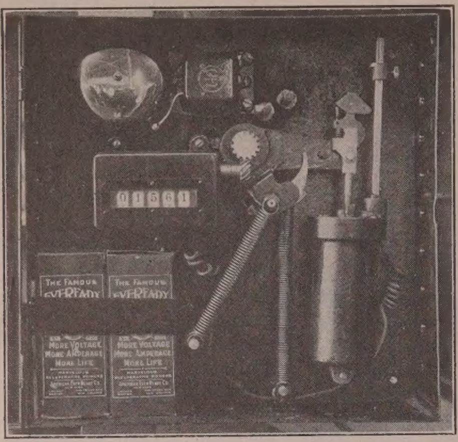
Examinations Previously Announced

Date		See Engineering Record
Jan. 2, 1915	Canal superintendent, Illinois and Michigan Canal Service	Dec. 12
Jan. 20, 1915	Junior railway civil and structural engineers	Dec. 19
Jan 23, 1915	Specification writer, grade II, assistant chemist, junior assistant engineering departments, junior draftsman, map draftsman, chief surveyor, and engineering draftsman	Dec. 26

Coming Meetings of National Engineering Societies

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West 57th St., New York. Meets first and third Wednesday, except in July and August. Next meeting Jan. 6. Paper: "The Waterproofing of Solid Steel Floors on Railroad Bridges," by S. T. Wagner.

CANADIAN SOCIETY OF CIVIL ENGINEERS. Secretary, Clement H. McLeod. Meets Thursdays, in Montreal, except during the months of May to September, inclusive.



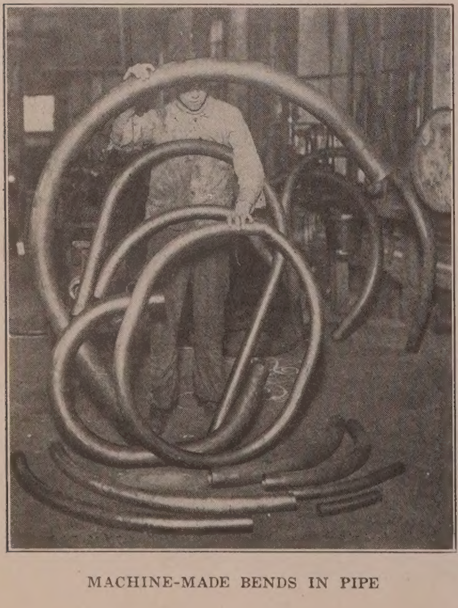
BATCH TIMER AND METER ON MIXER

New Mixer Appurtenance Shown at Road Builders' Convention

One of the few new devices which was exhibited at the convention of the American Road Builders' Association in Chicago, Dec. 14-19, was a combination batch timer and meter attached to the latest type of Koehring mixer. Its functions are threefold: It registers the number of batches on the meter, rings a bell when the mix is completed according to the time alloted for the mix, as required in the specifications, and lastly serves to speed up the work and prevent the mixer operator from becoming lax as to the time of mix. The bell may be set to ring for any period of time. Both bell and meter are enclosed in a small glass case on the side of the mixer and a lock is provided so that the engineer in charge can prevent any tampering with either bell or register. The device was brought out by the Koehring Mixer Company, of Milwaukee.

New Pipe Bending Machine

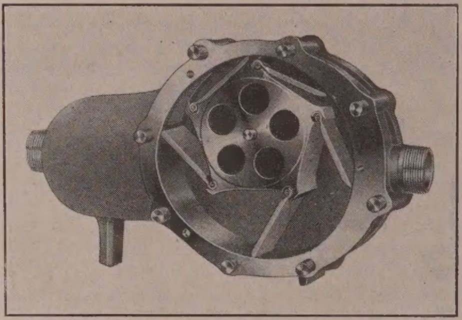
The J. Fillmore Cox Company, of Bayonne, N. J., has perfected a large cold bending machine which handles pipe 1 to 6 in. in diameter and bends to a radius of 3 in. to 6 ft., without filling. This machine will also bend reinforcing and structural shapes. The machine is driven by a General Electric 5½-hp variable speed motor, with drum type controller. The machine is fitted with special setting and duplicating arrangements, enabling accurate bends to be made at the first operation. Several diverse bends can be made on the machine in one operation. It is claimed that an 18-in. U-bend in 4-in. pipe can be made in one minute. This company also makes smaller portable bending machines of several types. The accompanying cut shows some bends made with this machine.



MACHINE-MADE BENDS IN PIPE

A Low Speed Volumetric Meter

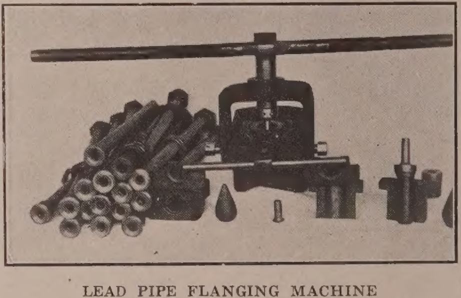
Running at low speed, the volumetric water meter illustrated on this page registers with accuracies which are claimed to be correct within 0.25 per cent. Compared with some meters now in common use it makes 18 revolutions in registering 1 cu. ft. as against 268 revolutions; there is, therefore, less chance for errors due to slip and friction of parts. A series of compartments within the meter chamber is formed by the vanes as the water pressure forces the blades ahead. The chamber is elliptical and the hinged vanes are held in contact with the side by springs and the force of the water. Both chamber and springs are of phosphor bronze and the vanes of hard brass. One-inch meters have chamber diameters of 7½ and 7 in. on the major and minor axes. The width is 2½ in., and the overall length 15½ in. The meter, which has been placed on the market by the Kruetzberg Meter Company, of Chicago, has been used for compressed air and oil measurements as well as for water.



LOW-SPEED VOLUMETRIC METER

Lead Pipe Flanging Machine

For making lead flange joint connections to take the place of wiped-joint goosenecks for water services, a new tool shown in the cut herewith has been placed on the market. The tool consists of a vise for holding dies and swage blocks and a bench anvil. Dies are furnished for extra heavy lead pipe generally used for corporation cocks of ½, ⅝, ¾ and 1-in. sizes. Four guide pins are used to protect the inside of the pipe while the flange is being formed in the die. After the flange is partly formed and before it takes its proper shape, this pin is replaced by a fuller mandrill applied by a screw press.



LEAD PIPE FLANGING MACHINE

W. J. Hatton, superintendent of the North Michigan Water Company, at Escanaba, Mich., patentee of the tool, claims that wiped connections ordinarily costing from 60 to 90 cents each can be made of flanged joints at an expense of from 5 to 7 cents each.

Motor-Driven Mine Pump

The illustration shows two motor-driven pumps developed specially for sump and gathering service in coal mines and tunnels. The motors are direct-current Westinghouse Electric machines. They are mounted on top of the pump, where they are kept out of the water and are supplied with impregnated windings, which afford protection from dampness. A special feature is the use of automatic control by which the pump can be started and stopped from any convenient point.

The unit formed by motor and pump is very compact and is readily mounted on a truck so that it can be easily transported from place to place as needed. The maker is the Weinman Pump Manufacturing Company, of Columbus, Ohio.

Business Notes

The Pacific Tank & Pipe Company has removed from its former offices to 275 Oak Street, Portland, Ore.

James C. Clow, vice-president of James B. Clow & Sons, large manufacturers of pipe and plumbers' goods, died Dec. 25 in Chicago.

Evans, Almiral & Company, manufacturers of heating and ventilating systems, have, owing to the death of the senior member of the firm, reorganized under the name of Almiral & Company, Inc.

The Erie Pump & Engine Works and the Northern Equipment Company have combined to form the Erie Pump & Equipment Company, with offices and works located at Erie, Pa. Mr. J. G. Pfadt, president of the Erie Pump & Engine Works, has retired from the business, and the new concern is headed by E. W. Nick.

Trade Publications

The following companies have recently issued trade publications:

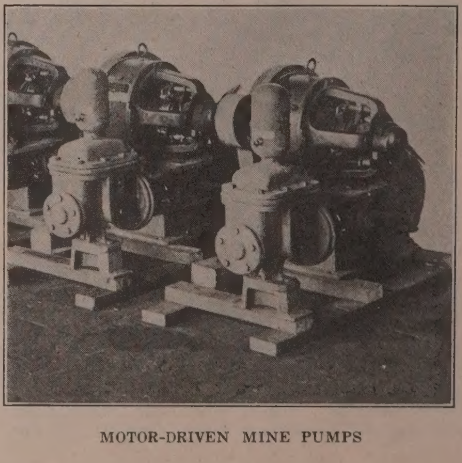
Century Cement Machine Company, Rochester, N. Y.—Folder describing the Century bag cleaner, an improved machine for recovering cement from empty bags and counting the bags.

Stow Manufacturing Company, Binghamton, N. Y.—Bulletin No. 400, a folding illustrated pamphlet describing small portable tools, such as grinders drills and borers, operated by flexible shafts.

Blaw Steel Construction Company, Pittsburgh, Pa.—Bulletin No. 63, 6 x 9 in., 24 pages, describing and illustrating the construction and adaptation of Blaw lap sheathing and column molds for concrete work.

Sandusky Portland Cement Company, Sandusky, Ohio.—Spanish catalog, 32 pages, 7 x 9 in., illustrated. Presentation to South American trade of the uses and special features of Medusa white Portland cement.

The Stone & Webster Engineering Corporation, of Boston, Mass., has issued an 18-page booklet describing the hydroelectric plants at Dundee Falls, Maine, and Fall Village, Conn. Plan drawings give the general arrangement of the development, while photographs of the completed plants and the construction work show what has been done. The text has no technical value.



MOTOR-DRIVEN MINE PUMPS